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ABSTRACT

Environmental problems affect the entire community and/or region. With this in mind, a workshop in the Weirton, West Virginia and Steubenville, Ohio area was organized to make participants more aware of their environmental problems and to involve them in the decisions concerning future environmental quality. This document contains the detailed sequence of events used in developing this workshop program and each of its stages: the preplanning stage; the planning stage; the workshop; and the evaluation. Appendices include the planning questionnaire, the letter of invitation, information on the workshop organization and content, and evaluations of the workshop and of air quality activities. This project was done in conjunction with the Ohio State University and the participants represented the major interests in the community. (MA)

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COMMUNITY ENVIRONMENTAL EDUCATION PROGRAMS ON AIR QUALITY IN STEUBENVILLE, OHIO AND WEIRTON, WEST VIRGINIA

U.S. DEPARTMENT OF HEALTH,
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** FINAL REPORT **

Prepared by:

Jo Ellen Force
Thomas A. Seliga
Ralph W. Swain

A joint project of

Atmospheric Sciences Program
Department of Industrial & Systems Engineering
Mershon Center for Education in National Security

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THE OHIO STATE UNIVERSITY

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I. INTRODUCTION

Many communities and regions are facing difficult decision situations in the area of environmental management. These situations are due to an increased awareness of the environment's limited ability to absorb wastes and the stronger restrictions imposed by environmental regulatory agencies. Both poor environmental quality and increased regulations have adverse effects upon the community. For example, poor air quality leads to a higher death rate from pulmonary diseases and to a reduction in the attraction of new industry. At the same time, efforts to reduce the level of air pollution may increase costs of production to a level where products are no longer competitive. Thus a region in such a situation is necessarily faced with electing actions which will benefit some community members over the planning period and be detrimental to other community members. It is not surprising that the process of resolving environmental problems is often slow and acrimonious. Many of the difficulties in achieving a solution could be reduced and cooperation could be enhanced if each of the community groups - business, industry, government, unions, and social and political organizations - had an improved understanding of the full range of the problem. In many existing situations the various community elements are unaware of the many impacts of poor environmental quality, do not understand the types of regulations that are being imposed, and have a restricted view of the alternatives available.

The following report documents the results of a sequence of workshops held in the Steubenville, Ohio-Weirton, West Virginia region during April and July of 1975. The purpose of the report is to identify the process of determining the nature and content of the workshops and to establish, to the degree possible, the reactions of workshop participants and the changes in community attitudes which may be a result of the environmental education activities.

The Steubenville-Weirton area is located on both sides of the Ohio River, 26 miles north of Wheeling, West Virginia, and 150 miles east of Columbus, Ohio. The 1970 population figures are as follows:

City of Steubenville	*30,771*
City of Weirton	*27,131*
Jefferson County (including Steubenville)	*96,193*
Hancock County (including Weirton)	*39,749*
Brooke County (including Weirton)	*29,685*
Steubenville-Weirton SMSA	*165,627*

The area has a serious and widely acknowledged air pollution problem. According to figures published by the Steubenville Air Pollution Bureau (which in 1971 became the Steubenville Air Quality Region, with monitoring sites in Weirton and other West Virginia locations), dustfall in the area ranges higher than 60 tons per square mile per month (the federal recommended limit is 15). Suspended particulates averaged 265 micrograms per cubic meter (the federal recommended limit is 75). Sulfur trioxide exceeded two micrograms per square centimeter per day (the federal recommended limit is 0.5). Certainly Steubenville-Weirton has sufficient air resources problems to justify research and environmental education activities.

Coal-burning heavy industry dominates both the air pollution picture and the employment picture. The Steubenville Area Development Council lists the principal industries and the number of wage-earners as follows:

Steel	*11,100*
Titanium	*1,150*
Railroad	*800*
Coal and slag	*750*
Clay products	*750*
Ferro-alloys	*510*
Electric power generation	*410*
Paper products	*315*
Fabricating	*315*

Steel dominates the power structure and psychology of the area. Evidence of this dominance is not difficult to find. The Steubenville Area Development Council and the Steubenville Area Chamber of Commerce are both led by steel representatives, and their publications reflect that leadership. The Chamber of Commerce "Action Report" frequently notes that "it's time [again] to salute steel!" and features a logotype profile of a plant with paisley swirls emerging from the smokestack. Steel is heavily represented on the boards of the College of Steubenville, the Ohio Valley Hospital, and other community philanthropies. Steel is also well represented in local government. The domination of the region by a single industry which is the primary source of atmospheric pollutants was a major factor in the workshop planning effort and had a major impact on the entire environmental education effort in the Steubenville-Weirton region.

II. PRE-PLANNING PHASE

2.1 Community Planning Sessions

Although considerable groundwork had been done during the preceding months, the first formal contact with the community, following awarding of the Environmental Education Grant, for the purpose of planning the community environmental education activities was made in August 1974. The objectives of these meetings were:

1) to meet representatives of government, industry, and health and welfare groups in the community;

2) to understand how the different segments of the community view the problems of air quality;

3) to establish a working relationship with representatives of the primary segments within a short time span;

4) to identify possible special topics and types of material which would be both valuable to and well-received by the community; and

5) to identify potential local participants in the community education activities.

The first meeting was held in the City Building in Steubenville, Ohio. Present at this meeting were local mayors and representatives from city administrations, local news media, health and welfare groups, the steel industry and the electric utility companies. A very active discussion of the various aspects of their air quality problem took place. It was apparent that the air quality problem in the Upper Ohio River Valley was of considerable concern to all of the parties present at this meeting.

Two days following the meeting in the City Building, a meeting was held at the National Steel Company Offices in Weirton, West Virginia, with representatives of the three major steel companies in the area. The steel company officials were apprehensive of the success of any community education activities. They contended that the Environmental Protection Agency was responsible for regulation and enforcement and that local citizens need not be involved. Nevertheless, they were interested in the effort and conceded that community education activities might serve some positive public relations purpose. They would not commit themselves either to representation or participation in the educational activities or a planned Conference on Air Quality (see Section 2.3).

Following these meetings, the workshop staff concluded the following:

1) The community as a whole is sincerely concerned about air quality with respect to:
    a) Health effects from long-term exposure to poor air quality;
    b) Community development impacts; and
    c) Possible economic effects of improving air quality.

2) There is confusion within the community concerning regulations. Few members of the community understand the regulation mechanisms. The different air pollution

indices and standards used by the local, state and federal agencies tend to further compound the problem.

3) Few people wish to blame industry for their poor air quality. They know the pollution is largely from industrial sources and are concerned that any major effort to curtail it may result in unacceptable economic consequences. There was general agreement that information concerning the costs and benefits of controlling air pollution should be addressed.

4) The major sources of air pollution in the area, the steel and electric utility companies, have to a great extent already decided on their strategies for meeting regulations. They are aware of existing standards and are actively lobbying at state and federal levels for new legislation on standards. They, more than anyone else, probably have the best estimate of what the air quality may be in the near future.

5) The steel industry feels there is no need for community participation in formulating its abatement plans. Therefore, it may be extemely difficult to obtain meaningful steel industry participation in any community environmental education activities.

2.2 NOVAA Survey

During this same period of time (July-September 1974), the North Ohio Valley Air Authority (NOVAA) conducted an Air Pollution Opinion Survey in the four county region along the Ohio side of the Ohio River. The results of this survey may be summarized as follows:

1) A majority of the people who were interviewed and lived in industrial (urban) areas were dissatisfied with the quality of air in their neighborhood. An even larger majority felt air pollution remains a major health hazard in the area.

2) Over three-fourths of the people in both industrial (urban) and rural areas of all counties did not feel the air quality had improved the past five years.

3) In 3 of the 4 counties over 95% of those interviewed said that they did not have any questions concerning air pollution that they would like answered. In the fourth county over one-half said they had no questions.

4) Approximately one-fourth of those interviewed said they would like to become involved in an organization whose main purpose is to clean up their environment.

Although these results indicate a community awareness of poor air quality, it is interesting to note that a majority were not interested in learning about the problem or contributing to its solution.

2.3 Salt Fork Conference

In addition to the above mentioned activities, a National Science Foundation supported Conference on Air Quality in the area was conducted in November 1974 by Drs. Seliga and Swain. The purpose of this conference was to bring interested groups together to discuss, define, and recommend solutions to the air quality problem. The results of this Conference, which was held at a state park lodge outside the community, also helped provide direction to the workshop staff in planning its environmental education programs. The Conference report (Seliga and Swain, 1975) included recommendations of three working groups. Of particular relevance to this educational effort were those of the Regulatory and Statutory Agency Representatives Working Group which proposed that:

> *The community must recognize and acknowledge that their air quality is poor and detrimental to their health and welfare. An organized program of community education is required, and the transfer of knowledge should be at a level which the general population can readily understand. Detailed technical information of only the most important relevance should be presented in order to facilitate communications to the broadest possible audience.*

and the Health and Welfare Representatives Working Group, which proposed that:

> *It is absolutely essential to continue to bring industry, labor, health and welfare groups, citizen's groups and regulatory agencies together in forums of this type to maintain community-wide momentum for improving over-all air quality.*

> *Community education on air pollution and its related problems is encouraged. The community should be presented with factual, understandable and significant information. This should increase citizen awareness of the problem and enable them to better articulate their views to industry and the regulatory agencies.*

A third group of business and industry representatives proposed a number of solutions, but none were related to any form of community education or citizen involvement.

The experiences of the Conference indicated the need for the workshop staff to provide a neutral location and environment for the educational workshops. A post-Conference evaluation also demonstrated the importance for all parties to have opportunities to learn more about the problem and to discuss them in a neutral, open forum. There was general agreement that improved air quality must be achieved while maintaining economic vitality. Among the recommendations for achieving this goal was a statement that:

> *Mechanisms for better understanding air pollution and its relationship to the quality of life should be made available to all segments of the community on a continuing basis.*

It should also be noted that in the Conference's final session, which brought all three working groups together, there was considerable heated debate over the issues.

2.4 Summary of the Pre-Planning Phase

As a result of the previously discussed activities, it was apparent that the Steubenville-Weirton area was aware of the need for community education about the air quality in the area. However, only a handful of citizens seemed ready and willing to take positive steps toward improving the community's understanding of its air quality problems. These concerned citizens believed that, although the community was aware of the problem, there was really very little understanding of the many facets involved of the alternatives available. Given the influence of the steel industry in the area and the national economic situation, it was unlikely that the community could be motivated to take an action-oriented position as the result of community education workshops. Thus, the workshop staff arrived at the following overall objective and subobjectives for the workshops:

2.4.1 Overall Objective:

To provide the citizens of the Steubenville-Weirton area with opportunities for obtaining an objective understanding of the problems associated with the air quality problem in their region.

2.4.2 Subobjectives:

1) Determine what could be done for the community that they could not do for themselves.
2) Select materials and activities that relate as directly as possible to the Steubenville-Weirton area's air quality problem.
3) Identify, utilize, and strengthen local resources and people whenever possible. This would help form a nucleus of accessible individuals who could provide continuation activities after the workshops have ended.
4) Invite participants which represent all the major interests in the community.
5) Use the public media as much as possible to keep the community informed of the workshop activities.

III. PLANNING PHASE

In order to increase the number of citizens who would attend the workshops and to determine the relative importance of the proposed study areas, it was decided to send out a questionnaire concerning workshop plans to the people who had already been identified as interested citizens. The purpose of this questionnaire (see Appendix A) was: (1) to help determine the amount of time to spend on each subject area; (2) to determine the day(s) of the week most desirable to the participants; (3) to determine the time of day most convenient; and (4) to obtain suggestions for other possible participants.

3.1 Questionnaire Results

The questionnaire was mailed to sixty-five people, out of which thirty-six, or 55%, responded. Of those responding, 50% or more were willing to spend one-half day on each of the four suggested topics. Furthermore, 28% were interested in spending an entire day on health effects of air pollution and 33% were willing to spend a day on the costs associated with air pollution damage and abatement. These results indicated a general acceptance of the four topics originally proposed by the workshop staff.

To evaluate the responses concerning the days of the week best suited to the citizens, a ranking system was used and led to the choice of a Wednesday and Thursday for a two-day workshop. Forty-seven percent were not interested in a Saturday workshop. Also, based on the questionnaire results, it was decided to have 9:00 A.M. to 4:00 P.M. sessions rather than evening sessions.

3.2 Workshop Format and Location

The workshop staff decided to conduct four separate sessions, each consisting of a half-day presentation, on the following four topics:

Topic 1 Basic information on the nature of air pollution. This topic included such matters as meteorology, primary sources of air pollution, and other related factors.

Topic 2 Detrimental effects of air pollution on health.

Topic 3 Costs of air pollution. This topic included, for example, property damage for citizens, costs of cleaning, loss of crops and other damage to vegetation, and reduced business development. It also included the costs of reducing air pollution to the Steubenville-Weirton community, costs to the local industries, and similar subjects.

Topic 4 The regulation process. This topic included what the regulations consist of, how they work, how the local citizen can inhibit or contribute to effective regulation, and other related topics.

Although everyone was urged to attend all four sessions, each session was intended to be a separate unit. This was done to encourage those who could not attend all sessions to attend the half-day sessions which their schedules permitted.

The basic format of each session was to consist of a knowledgeable speaker or panel of speakers to address the pertinent topic, followed by a question and answer period, moderated by the workshop staff.

The auditorium of the Jefferson Technical Institute, a community technical school in Steubenville, was chosen as the site for the workshop. This location was suggested to the staff by a number of local citizens. Furthermore, a letter was received from Dr. Fred S. Robie, President of Jefferson Technical Institute, offering the use of the Institute's facilities.

IV. WORKSHOP OF APRIL 16-17, 1975

4.1 Participants

In addition to the sixty-five identified potential participants, information was mailed to all others suggested by this group, all the physicians in the area, public school administrators and board of education members, agricultural extension agents, labor union leaders in the area, officers in many community organizations and to those on mailing lists provided by NOVAA and the Southeastern Ohio Health Planning Association. Industry representatives were also invited. Overall, approximately 300 citizens in the area received the information and registration cards for the first workshop, which was held April 16 and 17, 1975. Each letter of invitation also included an extra registration card for distribution to someone else. A copy of the letter is in Appendix B. Advertising space was also purchased in the three local newspapers, the *Steubenville Herald Star*, the *Weirton Times*, and the *Wheeling Intelligencer*. The ad stated the purpose and content of the workshops and invited all those interested in attending to complete and return the registration card. The ads were printed for three consecutive days three weeks prior to the workshop and again for three days immediately preceding the workshop. Several registration cards and inquiries were received from the newspaper readers.

In addition to the above, other publicity included an editorial on the upcoming workshop in the *Wheeling Intelligencer* on April 1 and a notice in the April 10th issue of NOVAA News, a newsletter of the North Ohio Valley Air Authority, which invited its readers to attend.

4.2 Workshop Content

4.2.1 Topic 1

The first one-half day session was concerned with basic information on the nature of air pollution and other related factors. The objectives of the first session were:

(1) To acquaint the participants with the primary pollutants in the atmosphere and the chemical composition of each. Particulates, sulfur oxides, nitrogen oxides, ozone and carbon monoxide and their reactions in the atmosphere were given particular attention.

(2) To interpret the basic meteorological and climatological factors operating in the river valley and the impact such natural phenomena have on a polluted atmosphere.

(3) To demonstrate the measurement devices used in the valley for measuring particulates and sulfur oxides and to discuss the standards associated with each pollutant.

(4) To classify the major emission sources in the valley and to explain the current technology available to control particulates and sulfur oxides.

Dr. Robert McQuigg, a chemistry professor from Ohio Wesleyan University, Dr. Michael R. Foster, an aeronautical engineer from The Ohio State University, Dr. Wid Painter, an environmental technology professor from Jefferson Technical Institute, and Dr. Thomas Sweeney, a chemical engineer from The Ohio State University addressed each of these four areas, respectively. The session ended with a panel discussion on the air pollution problems in the Ohio River Valley. Dr. Thomas A. Seliga of the workshop staff chaired this first session.

4.2.2 Topic 2

The afternoon session of the first day was directed toward the health effects of living in an area of poor air quality. The objectives of this session were:

(1) To review the Clean Air Act and its relationship to the protection of public health.

(2) To establish what a health effect is and the parameters involved in defining levels of severity.

(3) To discuss local health issues in a moderator-panel format with local health community members.

The speaker for this session was Dr. H. E. Griffin, Dean of the Graduate School of Public Health at the University of Pittsburgh. He is also Chairman of the National Academy of Science's Air Pollution Health Effects Task Force. Dr. Griffin's presentation addressed the first two objectives.

The local coroner and pathologist, two other local physicians, an administrator at a local hospital, and a local health commissioner were invited to participate in the panel discussion along with the invited speaker. However, on the day of the workshop the health related professionals, who had previously agreed to be part of the panel, did not participate for a variety of personal reasons. Whether there was a reluctance on the part of some of these people to participate because of a recent *Philadelphia Enquirer* article on air pollution and health in the area in which some of the physicians had been quite candidly quoted is not known.

Dr. Geraldine Clausen of the workshop staff chaired this session.

4.2.3 Topic 3

The morning session of the second day was to address the economic factors involved in the air quality problem.

The overall objective of this session was:

> To provide an integrated view of the economic decisions in air pollution control through comparison of the marginal benefits of reducing pollution to the marginal costs of reducing the associated emissions.

This was done by:

(1) Presenting a review of the types of costs to a society and its individuals in an area of poor air quality. The means of associating dollar costs with physical effects were also discussed.

(2) Providing basic information about the costs to industry of reducing emissions. Capital and operating costs of alternative abatement methods were examined.

Dr. Lester Lave, a nationally known economics professor from Carnegie-Mellon University, addressed the first issue and Mr. Richard B. Engdahl, a scientist from Battelle Memorial Institute, presented information on the second issue. Dr. Ralph Swain of the workshop staff chaired this third session.

4.2.4 Topic 4

The final session's topic was the regulatory process. The objective of this session was:

> To provide the participants with knowledge of the role and responsibilities of local, state, and national regulatory agencies in the region.

Mr. Pat DeLuca of the North Ohio Valley Air Authority, Mr. Steven Smallwood of the West Virginia Air Pollution Control Commission, Mr. Steven Taylor of the Ohio EPA, and Mr. Thomas Voltaggio of the U. S. EPA (Region III) discussed the roles of their respective agencies in the region. The local representatives also presented their assessment of how rapidly air quality was improving in the area. The workshop concluded with a panel discussion by these representatives in response to questions and comments of the participants. Dr. Seliga chaired this final session.

4.3 Summary

A total of sixty-six area residents attended at least one session of the two-day workshop. Most people attended more than one session with an average attendance at each session of about forty.

The attendees came from a variety of backgrounds. People were present from local lung associations, electric utility industries, other area industries, the medical profession, community organizations, the local college and some local high schools. Thirty-five percent of the participants lived in Steubenville and forty-five percent came from seventeen other Ohio towns in the area. The remaining twenty percent came from six West Virginia towns.

Representatives from area newspapers covered the workshop and the local television stations reported the activities, including interviews with staff members, on the evening news.

In general, the information presented was well received. As expected, the session on economics was the most controversial. The electric utility companies' representatives disagreed over some of the abatement costs that were quoted. The steel industry chose to send no representatives, so their views were not available. Nevertheless, several participants in the workshop reported their perceptions of the steel industry's views.

A variety of written materials, primarily from the Environmental Protection Agency and the American Lung Association, were made available to the participants. Some of the speakers, also, provided hand-out material.

A staff paper entitled, "A Cost Benefit Approach to a Community's Air Quality," prepared by Ms. Jo Ellen Force of the workshop staff was distributed during the economics session. A list of all the materials distributed at the workshop, a copy of the staff paper, and the workshop program are given in Appendix C.

4.4 Evaluation

Following the workshop, an evaluation was sent to the sixty-six participants. Approximately 55% of them returned the completed evaluation. The evaluation and tabulated results are given in Appendix D. The evaluation can be summarized as follows:

(1) A significant majority of those attending thought the level of material presented in all session was appropriate.

(2) A majority stated that all sessions provided them with new information and understanding of the air quality problem.

(3) A large majority felt the materials distributed at the sessions were useful.

(4) A slight majority agreed that the economic session addressed the real issues of the economic situation and that both aspects of the issue were presented fairly.

(5) There was considerable interest expressed in the need for studying the following in more detail:

   a. local health costs;
   b. local control costs to industry;
   c. the local incidence of respiratory and heart disease;
   d. air pollution control equipment as related to local emission sources; and
   e. point sources and emissions in the area.

(6) Almost everyone thought workshop speakers should be drawn from both the local area and outside experts.

(7) There was no consensus as to what kind of session(s) would attract more members of the community.

(8) The most frequently mentioned criticism of the workshop was the use of and references to outdated data, particularly in the area of economics. This was seen as a significant problem in estimating the real costs of pollution abatement or damage.

V. WORKSHOP OF JULY 29-30, 1975

As a result of the evaluation of the April Workshop and logistics, the staff developed the following overall objective for the second workshop:

> To provide a small group of highly interested citizens with more in-depth information concerning the local air quality problem.

This was to be accomplished by:

(1) Responding (to the degree possible) to information requests expressed in the evaluation of the April workshop.

(2) Selecting participants on the basis of previously demonstrated interest. The assumption was that previous participants had a reasonably good understanding of the basic problem.

(3) Utilizing the small group discussion format in order to facilitate interaction.

In addition, it was hoped that, out of the citizens selected, several persons would come forth to assume leadership roles in the community's future efforts to improve its air quality.

It was decided to hold three separate sessions in a one and one-half day workshop at the Millsop Community Center in Weirton, West Virginia. In order to encourage interaction and to provide continuity between sessions lunch was catered at the Community Center each day. This turned out to be very beneficial as it provided an opportunity for the citizens to interact with each other in a relaxed learning environment and for the staff to become better acquainted with the participants.

Twenty-nine residents of the community attended at least one session of the second workshop. Thirty-four percent were from West Virginia, forty-five percent from Steubenville and twenty-one percent from other Ohio towns in the region. Nearly all of these participants attended as private citizens. A copy of the program is given in Appendix E.

5.1 Session 1

The first half-day session was designed to be a self-assessment of the local situation. The director of the North Ohio Valley Air Authority, Mr. Pat DeLuca, and the area's regional engineer for the West Virginia Air Pollution Control Commission, Mr. Steven Smallwood, were resource people for the session. The session called for active participation by the citizens. Their tasks required them to:

(1) Identify and locate the major sources of pollutants in the valley on 7½-minute topographic maps of the area.

(2) Indicate on the maps the quantities and types of pollutants emitted at each source.

(3) Locate all monitoring sites on the maps and to indicate what pollutants are monitored.

(4) Become informed of the status of each emitter's compliance with the regulations.

The participants helped locate the emission sources on the maps and were very interested in this activity and the information presented. Extra copies of the completed maps were later prepared by the workshop staff and sets were returned to the West Virginia Air Pollution Control Commission and the North Ohio Valley Air Authority for use in their work with the public.

5.2 Session 2

During the afternoon session citizen participation and the legal process as related to air quality was the topic. The resource people present included Mr. Brent English, Director of the Air Pollution Study Group, Inc., Mr. Ed Carter, Program Director of the Central Ohio Lung Association, and Dr. Thomas Sweeney, Professor of Chemical Engineering at The Ohio State University. The session was designed to:

(1) Provide participants an opportunity to discuss other community problems in relation to its air quality problems.

(2) Review the legal processes available to citizens in seeking enforcement of air quality regulations.

(3) Discuss citizen actions other than legal processes. There was considerable interest among participants to reactivate the Ohio Valley Environmental Council.

5.3 Session 3

The final session of this workshop addressed the issue of the effects and costs of poor air quality to the local citizen. Dr. Swain of the workshop staff presented material the staff had compiled which related these costs and effects to the local area. This material along with a list of other available materials are presented in Appendix E. The purposes of this session were:

(1) To present and examine major epidemiological studies that have been conducted in other locations to determine health-related effects of poor air quality and to ascertain how such effects were measured.

(2) To provide information about the socioeconomic status of the community and neighboring areas in the two states.

(3) To discuss other possible costs, such as materials damage and vegetation damage that may result from poor air quality.

(4) To consider the overall impact of environmental controls on the national economy.

All the material presented appeared to be well received and generated considerable interest and discussion among participants. The need for further research to determine the effects of the air quality on the valley residents became apparent to the participants.

VI. OVERALL EVALUATION

Following the second workshop, an evaluation of the year's activities was made by examining responses to a questionnaire sent to twenty-five of the participants (see Appendix F). This questionnaire was designed to elicit subjective attitudes. Ten participants responded. Their comments can be summarized as follows:

(1) There was general agreement among participants that the workshops increased citizen awareness of the need to improve the region's air quality. Some citizens who have been involved in air quality activities for several years felt that the air quality is improving somewhat.

(2) Almost all of those who returned evaluations are involved or plan to become involved in community activities concerning air quality.

(3) There was general concern about methods of getting more citizens involved. The absence of members of the medical profession, labor organizations and young people in the community was noted by several people.

(4) A majority felt that both a small group workshop format and large group lectures are needed to educate the community. Although most stated that a small group is more productive for the participants and is needed to gather information and material, they also favored large community meetings in order that more citizens could learn about the problem.

The respondents also made several comments and suggestions concerning possibilities for future community activities. Everyone felt there was need for further activities, which might include:

(1) A community college based course in continuing education (or adult education) on air quality issues.

(2) The development of a Speakers Bureau to provide programs for local organizations.

(3) A short series of workshops that would require participants to collect data and read material between sessions. It was generally felt that only a few members of the community would be willing to make this kind of commitment.

Most felt there is a need for an outside group to be involved in community education activities in order to present an objective view of the problem, to provide expertise and to act as a moderator between local adversaries. Specific comments from some of the returned evaluations are also included in Appendix F.

6.1 Community Developments

The workshop staff is aware of the following two developments in the community since the workshops. The genesis of both has been attributed in part to the workshops by those involved.

First, the Ohio Valley Environmental Council has reorganized. A meeting was held following the July workshop and officers were elected. In addition to printing and distributing a newsletter, the group plans to monitor compliance and variance schedules of the local industries, and remind citizens of their rights in the area of air quality.

Secondly, the East Central Ohio Lung Association and the West Virginia Lung Association are presently working on a one-day workshop to be held in the Wheeling area in late fall 1975. This will be the first program work of lung associations in the area to cross state lines. One of the people involved in organizing this project feels that the workshops of April and July were "partly responsible for bringing the two associations together to work on a common cause."

6.2 Summary

The overall objective for this environmental education activity was:

> To provide the citizens of the Steubenville-Weirton area with opportunities for obtaining an objective understanding of the problems associated with the air quality problem in their region.

This objective was fulfilled by conducting two education-oriented workshops, one in each city. The most important aspects of this effort are summarized below:

A) Both workshops were open to any citizen of the area who desired to attend. Over three hundred citizens were personally contacted, plus readers of three area newspapers had access to workshop information. Seventy-six different people attended one or both workshops.

B) Opportunities were provided during the workshops for the various subgroups to respond to the issues raised. At one point, time was provided during a session for an impromptu presentation on tall stacks by an engineer from one of the electric utility companies.

C) The workshop evaluations indicated that the topics discussed were relevant and informative to the participants. The participants were also pleased with the credentials of the experts who contributed balanced information on the various topics addressed.

D) At each workshop an effort was made to present the pros and cons of the issues involved. The general feedback indicated that third party objectivity was maintained by the staff and that such objectivity is vital to the success of environmental education activities.

The overall objective might have been more completely fulfilled if more representatives of labor and the medical profession had attended either workshop.

The subobjectives were:

(1) To enable the participants to take a more informed role in managing their environment if they choose a course of action.

(2) To create a neutral environment for divergent groups within the community to meet and discuss the air quality problem.

(3) To reduce both the adversary and patronizing attitudes that are held on this subject.

(4) To establish a continuing forum for the study of the area's air quality problem.

Numbers one and four were met since the citizens have reactivated the Ohio Valley Environmental Council. The Council has been expanded to include a West Virginia Division and an Ohio Division. It is presently planning program goals for the coming year.

According to the participant's evaluations subobjective number two was satisfactorily met both in terms of the physical locations that were chosen and in the learning environments that existed during the workshops.

Progress was made on subobjective number three. The attitudes toward the local agencies in air pollution enforcement were improved through their participation in both workshops. However, it was evident that significant reduction in adversary attitudes toward the air pollution problems as a whole are heavily dependent upon many national factors. Of particular importance during 1974-75 were the relationships of air pollution with the economy, unemployment, energy, and environmental statutes.

A significant insight gained by the staff during this project was the potential importance of conducting the workshop during periods when the environmental problem is most in the public mind. For example, it was apparent that interest in air quality workshops would have been significantly greater had they coincided with periods of poor air quality. Due to meteorological conditions in the eastern United States the rate of occurrence of local inversions and air stagnations is greatest during the late summer and autumn months. Consequently, citizen interest in air quality is much greater during the autumn than at other times of the year. Although it was not possible to hold autumn workshops under this project, this factor should be given serious consideration by anyone planning future environmental education activities concerning air quality. Other areas of environmental education might also benefit by matching activities with occurrence of the problem.

6.3 Recommendations

The activities that took place in 1974-75 in Steubenville-Weirton are a beginning in environmental education endeavors in the region. Other avenues of reaching more people and informing them about the problem and related issues need to be considered. However, it must not be assumed that educating more people will result in a stronger community commitment for cleaner air. Rather, one should expect that a better informed citizenry would result with greater hope for their ability to influence decisions concerning the environment in which they live.

Donohue, Olien and Tichenor (1974) discussed the relationship between information and action in their research involving northern Minnesota communities. They found that other sociological factors of the community tend to dominate environmental literacy. The larger, more differentiated and urbanized a community is, the greater its tendency to show concern about environmental objectives. This type of community also is most apt to accept environmental regulations. The greater adaptability and resilience of the larger urban center appears to be a major factor in a community's motivation to take actions that will improve their environment. Another very important determinant of interest in the problem is the individual's remoteness to the problem and/or immunity to the consequences of increased regulation of pollution.

The influence of both of these factors seemed evident in the attendance at the workshops. In both workshops the greatest citizen participation was from Steubenville, the most urbanized of the communities in the region. Also, there was very little participation by citizens employed at local industrial concerns. Several of those who did participate were in public positions and tended to maintain a low profile. They generally equated any efforts to clean up the air with decreased employment opportunities in the area.

Thus, any future efforts must consider these and possibly other sociological factors in attempting to increase participation in air quality activities. This should be combined with the recognition that increased knowledge about the problem may not result in a commitment to improve the air quality.

The feedback from the participants suggested three possible alternatives for further educational activities. They are:

(1) A community college course on air quality issues.

(2) A Speakers Bureau for local organizations.

(3) A non-credit series of workshops in which attendees gather data and more information.

In the summary of a report on community oriented environmental education in Alma, Michigan, Davis and Surls (1975) stated that

> *It is much more effective (than on-campus courses) to concentrate community involvement efforts in non-coursework areas such as 'topic brainstorming sessions' and in the area of communication and cooperation with local citizen's groups and service clubs. These organizations provide established and nonthreatening vehicles for community involvement in environmental problem solving.*

Furthermore, in a survey of community organizations in Decatur, Illinois, a community similar in size to Steubenville-Weirton, Kronus (1974) found that nearly half (48 percent) of the community organizations stated that they were interested in environmental quality. Ninety-one percent of these organizations followed up this interest by participation in one or more activities aimed at promoting the goals of environmental improvement. This participation was most often (57 percent of the organizations) the sponsoring of a speaker to discuss an environmental problem. Therefore, if further air quality educational activities are undertaken in Steubenville-Weirton, it would appear that the development of a Speaker's Bureau or Panel to provide programs for local organizations is a logical next step. The nucleus for establishing such a panel exists as a result of the past year's activities. Once such a panel reaches many more community members via the existing organizations, there may be a large enough base to establish an action oriented program or to apply pressure on the area's industries to respond to the need for an improved air environment in the region. Despite efforts of the enforcement agencies in the region, without citizen support and involvement, no significant improvement in the air quality seems likely in the near future.

REFERENCES

Davis, Craig B. and Fred Surls (1975), "Community-Oriented Environmental Education," *Journal of Environmental Education*, *6*, No. 4, pp. 9-13.

Donohue, G. A., C. N. Olien, and P. J. Tichenor (1974), "Communities, Pollution, and Fight for Survival," *Journal of Environmental Education*, *6*, No. 1, pp. 29-37.

Knonus, Carol L. (1974), "Involvement of Community Organizations in Environmental Quality," *Journal of Environmental Education*, 5, No. 4, pp. 34-36.

Seliga, Thomas A. and Ralph W. Swain (1975), "Summary Report on the Conference on Air Quality in the Steubenville-Weirton Standard Metropolitan Statistical Area," Salt Fork State Park Lodge, Cambridge, Ohio, November 7-8, 1974.

APPENDIX A

Planning Questionnaire

NAME ______________________________

We are planning a series of air quality workshops for the Northern Ohio Valley community to be held in the Steubenville-Weirton area in the near future. In order to plan these workshops more effectively, we would appreciate your response to the following.

1. We are proposing the following content areas and would like to know which ones interest you.

Topic 1 Basic information on the chemistry and related factors. This topic includes such matters as meteorology, primary sources of air pollution, and other related factors.

Topic 2 Detrimental effects of air pollution on health.

Topic 3 Costs of air pollution. This topic includes, for example, property damage for citizens, costs of cleaning, loss of crops and other damage to vegetation, and reduced business development. It also includes the costs of reducing air pollution to the Steubenville-Weirton community, costs to the local industries, and similar subjects.

Topic 4 The regulation process. This topic includes what the regulations consist of, how they work, how the local citizen can inhibit or contribute to effective regulation, and other related topics.

For each topic you are interested in, how much time would you be willing to spend?

Topic 1	__ ½ day	__ 1 day	__ not interested
Topic 2	__ ½ day	__ 1 day	__ not interested
Topic 3	__ ½ day	__ 1 day	__ not interested
Topic 4	__ ½ day	__ 1 day	__ not interested

2. What other air quality topics or issues would be of interest to you?

(please turn over)

3. Please indicate the days of the week you would be able to participate in a workshop by placing the number one (1) next to the preferred day(s), number two next to the second most preferred day(s), etc. For any days you would not be able to participate, please place a zero (0) beside that day(s).

__Monday __Tuesday __Wednesday __Thursday __Friday __Saturday

4. Please indicate the time of day for participation in a workshop by placing the number one (1) beside the most preferred time, etc. Please place a zero (0) beside any time that you cannot attend.

__ Morning and afternoon session
__ Afternoon and evening session
__ Friday evening and Saturday morning sessions

5. If you know of others in the community whom you think might be interested in attending the workshops, please list their names and addresses below.

APPENDIX B

Letter of Invitation

March 21, 1975

Dear Northern Ohio Valley Resident:

You are invited to attend a 2-day community Workshop on Air Quality in the Northern Ohio Valley. The Workshop will consist of 4 one-half day sessions covering four areas of air quality: the nature and sources of local air pollutants, the health effects of air quality, the economics of air quality and the regulation process. The topics are explained in more detail in the enclosed program.

The Workshop will be held on Wednesday, April 16 and Thursday, April 17, from 9:00 AM until 4:30 PM each day. Jefferson Technical Institute in Steubenville is providing their facilities for the conduct of the Workshop. There will be no charge for participating in the activities. The Workshop is sponsored by the Office of Environmental Education of the U. S. Department of Health, Education, and Welfare, in cooperation with agencies and institutions in the Steubenville-Weirton area and is being conducted by The Ohio State University.

We hope you will be able to attend all four sessions. However, if this is not possible, please register for those sessions you wish to attend. We are enclosing a registration card to be completed and returned by April 1. Extra programs and registration cards are enclosed in the hope that you will pass them on to other residents of the area who would be interested in attending. Thank you for your assistance.

We hope to see you April 16.

Sincerely,

Ralph W Swain

Ralph W. Swain, Assistant Professor
Industrial & Systems Engineering

Thomas A. Seliga

Thomas A. Seliga, Director
Atmospheric Sciences Program

Geraldine T. Clausen

Geraldine T. Clausen, Research Associate
Mershon Center for Education

/mm
Enclosures

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2015 Neil Avenue
1468-340187

REGISTRATION CARD *Please return by April 1*

WORKSHOP ON AIR QUALITY IN THE NORTHERN OHIO VALLEY

April 16-17, 1975 Jefferson Technical Institute

NAME ________________________ Phone No. ____________

ADDRESS ____

I plan to attend the following sessions (please check):

___Basics, Wed. Apr. 16, AM *___Economics, Thu. Apr. 17, AM*
___Health, Wed. Apr. 16, PM *___Regulation, Thu. Apr. 17, PM*

___I cannot attend any part of this workshop, but I would like to be informed of any future workshop.
___I have no interest in the workshop.

APPENDIX C

April 16-17, 1975 Workshop

Workshop Program
Materials Available
Staff Prepared Paper

STEUBENVILLE-WEIRTON AIR QUALITY WORKSHOP

APRIL 16-17, 1975

Lecture Hall
Jefferson Technical Institute
4000 Sunset Boulevard
Steubenville, Ohio

Wednesday, April 16

9:00 AM *Air Pollutant Characteristics, Behavior, and Measurement*

Moderator: Thomas A. Seliga, The Ohio State University

The Nature of Primary Local Air Pollutants, Their Sources and Measurement Methods. The Effects of Meteorology and Topography Upon Local Air Quality.

Speakers:
Robert McQuigg, Ohio Wesleyan University
Michael R. Foster, The Ohio State University
Wid J. Painter, Jefferson Technical Institute
Thomas L. Sweeney, The Ohio State University

NOON Lunch

1:30 PM *Health Effects of Air Pollution*

Moderator: Geraldine T. Clausen, The Ohio State University

The Detrimental Effects of Air Pollution on Health

Speaker: Herschel E. Griffin, MD, University of Pittsburgh

Thursday, April 17

9:00 AM *The Economics of Air Quality*

Moderator: Ralph W. Swain, The Ohio State University

The Role of Air Quality as a Free Good, The Costs Associated With Poor Air Quality and The Costs of Reducing Pollutant Emissions

Speakers:
Lester Lave, Carnegie-Mellon University
Richard B. Engdahl, Battelle Memorial Institute

NOON Lunch

1:30 PM *The Regulatory Process*

Moderator: Thomas A. Seliga, The Ohio State University

The Function of Each Regulatory Agency Associated With the Region, The Dynamics of the Regulatory Process (Alerts and Standards Compliance), and Mechanisms for Local Input

Speakers:
Patrick DeLuca, Northern Ohio Valley Air Authority
Steven Smallwood, West Virginia Air Pollution Control Commission
Steven Taylor, Ohio Environmental Protection Agency
John B. Rasnic, U. S. Environmental Protection Agency

SPONSORED BY THE OFFICE OF ENVIRONMENTAL EDUCATION
OF THE
U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Materials Available at April Workshop

"Clinical Applications of Air Pollution Research: The Data Base," by H. E. Griffin. Presented at the American Medical Association Air Pollution Medical Research Conference, December 5-6, 1974, San Francisco, California.

"A Cost-Benefit Approach to a Community's Air Quality," Staff Paper prepared by Jo Ellen Force, March, 1975.

"A Dictionary of Air Pollution Terms," Air Pollution Control Association, 4 pages.

"The Ohio State University Steubenville-Weirton Air Quality Workshop," by Steve Smallwood. Presented at the Regulatory Session, April 17, 1975, Steubenville, Ohio.

The Ohio Tuberculosis and Respiratory Disease Association provided the following:

"Air Pollution Explained: What You Can Do"
"Air Pollution, The Facts"
"Air Pollution Primer"
"Asthma, The Facts"
"Bronchiectasis, The Facts"
"Controlling Air Pollution"
"Your Lungs, The Facts"

The U. S. Environmental Protection Agency provided the following:

"A Citizen's Guide to Clean Water"
"Action for Environmental Quality"
"Air Quality Criteria for Carbon Monoxide: Summary and Conclusions"
"Air Quality Criteria for Hydrocarbons: Summary and Conclusions"
"Air Quality Criteria for Particulate Matter: Summary and Conclusions"
"Clean Air and Your Car"
"In Productive Harmony"
"Questions and Answers about Nuclear Power Plants"
"Research and Monitoring--Cornerstone for Environmental Action"
"The Challenge of the Environment--A Primer on EPA's Statutory Authority"

A COST-BENEFIT APPROACH TO A COMMUNITY'S AIR QUALITY

Prepared by Jo Ellen Force, March, 1975

Introduction

The quality of air in a community is a very controversial subject. If the air quality is poor, everyone suffers to some degree and everyone would like to see something done about it. But, everyone also contributes to poor air quality in their normal routine activities. Thus, when control measures are suggested, no one wants to be the one to change their normal activities or have their job adversely affected by such control. It is often thought that air quality control will cost significantly more than it presently costs to live in areas of poor air quality. Only if it can be shown that it is more costly to live in polluted air than it is to control the pollution can the level of pollution be expected to decrease. Thus, two important questions can be asked: 1) What does it cost to live in areas of poor air quality? and 2) What is an acceptable air quality level for a particular community given the costs of control?

A technique based on the costs of control versus the benefits from such controls that can be used to determine the acceptable air quality level in a community will be discussed first. This discussion will then be followed by a review of some previous attempts to determine the costs of living in areas of poor air quality.

Cost-Benefit Approach

One approach to the problem of defining acceptable air quality is to apply an economic evaluation in the form of a cost-benefit analysis. It is important that both costs of pollution abatement and the benefits of such abatement be combined in order to have a meaningful analysis of the overall economic impact. The majority of studies reported thus far have dealt with only one-half of this relationship. The studies either attempt to determine how much it will cost a certain industry to install air pollution control equipment in order to meet specific standards and regulations, or they attempt to quantify the cost of various pollution levels to the citizens of the community in terms of health effects, materials damage, vegetation effects, and other detrimental effects.

However, a study by Wilson and Minnotte (7) presents a technique that the authors believe can be used "to find the level of pollution abatement in an area that balances the cost of controlling pollution with the benefits received from its control."

The basic objective of this technique is to maximize the net benefit to the entire community from air pollution control. The net benefit is defined as the difference between the total costs to the community of reducing the level of pollution and the total benefits received by the community from the reduction. The community is defined as both those who produce the pollution (the emitters) and those who experience the effects of the pollution (the receptors). The subobjective of this technique is to examine each emitter in the area separately and to find the level to which its emissions must be controlled to result in the maximum net benefit to the community.

Receptor Zones

There are three parts to be completed with this technique in order to achieve the basic objective. First, the receptor zones must be established. No area large enough to be considered for cost-benefit analysis, for example, an Air Quality Region, will have a uniform pollution level throughout. The level of pollution at any particular place is dependent upon many factors, such as its relationship to pollutant sources and meteorological variables. The concentration of pollutants at a particular receptor point is very important in determining the benefits that can result in a reduction of the pollution level.

Therefore, in order to determine a realistic relationship between source emissions and the benefits to be derived from their reduction, the entire study area must be divided into receptor zones small enough that each zone can be assumed to have a pollution level that is uniform throughout the zone. The population density in each zone must also be determined. The local air authority may have data that can be used to initially determine the receptor zones. It is convenient if the zones follow census tract boundaries so that population densities can be calculated easily from already existing census data. Once the pollution level and population density are established in each zone, the benefit functions can be formulated. These benefit functions define the benefits to be received in the respective zone from various reductions in the pollution level.

A receptor point is located within each receptor zone so that source contribution to the zone's air quality can be determined. Possibly, existing collection sites of the local air quality agency could be used. Additional ones may need to be established. A decision must be made concerning what pollutants will be measured and what reduced. In an example application to the Washington, D. C. area in Wilson and Minnotte's study only suspended particulate pollution was considered. This application also dealt only with annual average pollution levels and not short term peaks. The assumption was made that the annual average pollution level at the receptor point representing a receptor zone was represented by annual average particulate pollution level.

Costs of Control

Second, after receptor zones are established and pollution levels measured, the costs of pollution control must be determined. In the Washington, D. C. application only stationary point sources were considered. . . ..

The cooperation of local industries must be secured in order to determine accurate costs functions. General cost functions for classes of industries can be obtained from the literature, but data specific to the local industries needs to be obtained in order to establish realistic cost functions. Thus, all stationary sources of the pollutants to be reduced must be determined.

All alternatives available for control of a particular pollutant emission must be determined next. These alternatives may include changes in fuel or the addition of specific pollution control equipment. There may also be several levels of pollution reduction available within a specific alternative.

Once sources and alternatives are identified, costs and resulting emission levels must be calculated for the many possible combinations of alternatives and levels within alternatives available for each particular source. Thus, a separate cost function will be calculated for each emitter in the entire Air Quality Region. Within each alternative, the least expensive steps for reducing emissions are the only ones considered. A schedule for each emitter of its least-cost control alternatives versus corresponding emission levels can then be drawn up.

To illustrate these schedules, two examples of actual emitters in the Washington, D. C. area are shown in Tables I and II. The first, which is arbitrarily called the XYZ Power Plant, has four possible control steps. The first column gives the particulate emissions in tons/year and the second column gives the annual control cost of the four possible alternatives.

Table I. XYZ power plant.

Particulate Emissions Tons/Yr	Control Cost $/Yr	Benefits $/Yr	Net Benefit $/Yr
230	0	0	0
58	33,900	195,000	162,000
53	102,300	200,600	98,300
49	204,800	205,200	400
45	482,500	209,700	−272,800

At the present state, the XYZ Power Plant emits 230 tons of particulates per year. It burns a 2% sulfur, 8.7% ash coal and is equipped with an electrostatic precipitator, which operates at 98% efficiency. Because this is the base level, the control cost is zero.

The first control step, which reduces the total emissions to 58 tons/year and costs $33,900/year, consists of upgrading the existing precipitator to an efficiency of 99.5%. The remaining three control steps utilize the upgraded precipitator along with fuel substitutions. At the emission rate of 53 tons/year, the 8.7% ash coal is replaced by 8.1% ash fuel. The last two steps use 7.5% ash coal and 6.9% ash coal, respectively. Note that the incremental cost for the last three reductions in particulate emissions increases quite rapidly.

Table II. ABC municipal incinerator.

Particulate Emissions Tons/Yr	Control Cost $/Yr	Benefits $/Yr	Net Benefit $/Yr
390	0	0	0
195	19,800	743,000	723,200
98	27,800	1,159,000	1,131,200
78	43,600	1,188,800	1,145,200
28	60,500	1,411,700	1,351,200
16	67,200	1,427,500	1,359,300

The second example, arbitrarily called the ABC Municipal Incinerator, has five possible control steps. At this present state, which is the base level, the ABC Incinerator has no existing air pollution control devices. The first reduction in emission rate from 390 to 195 tons/yr. may be accomplished by installing a baffled spray chamber at an annual cost of $19,800/yr. The next two reductions may be accomplished by adding first a cyclone collector and then an electrostatic precipitator in series with the spray chamber.

The next reduction of emissions to 20 tons/yr. may be accomplished with a wet scrubber while the last control step utilizes a higher efficiency scrubber. Note in this case that the incremental costs for maximum possible reduction are not nearly as large as the XYZ Power Plant costs.

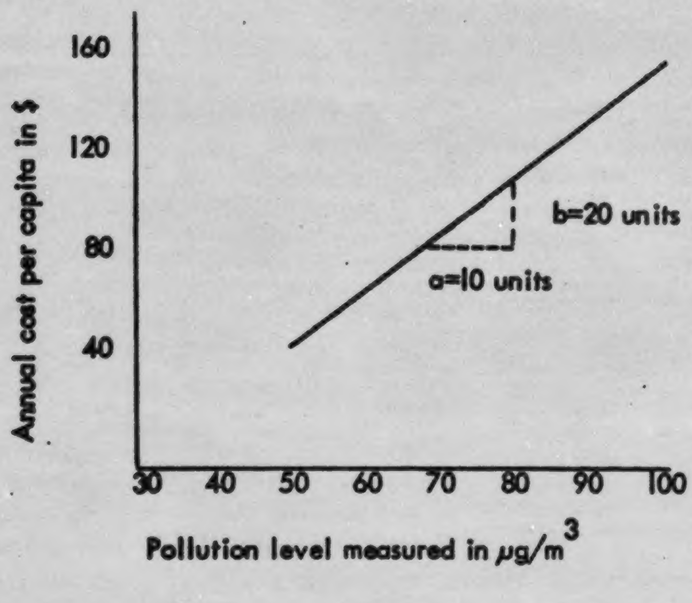
Benefit Functions

Finally, after receptor zones are established and emitter schedules are drawn up, the benefit functions for each emitter must be determined. Because an emitter will have some effect in each receptor zone, its benefit function will depend upon the damage functions in each of these zones.

The damage functions in the Washington, D. C. application were derived from the data collected by Michelson (4) in a study of residential soiling costs in the Washington area. Residential soiling was the only type of particulate damage considered in the study.

Michelson demonstrated that air pollution causes meaningful soiling, and correlated time intervals between cleaning and maintenance operations with levels of air pollution. He compared the frequency of performing certain cleaning and maintenance activities in several areas of the Washington, D. C. area. Using this information, a relationship between air pollution levels and frequency of cleaning was determined. The frequency was then converted to a cost per capita. The curve depicting this relationship between cost per capita in dollars and pollution levels in $\mu g/m^3$ was represented by a straight line equation. (See Figure I) For example, if the pollution level is 70 $\mu g/m^3$, the cost per capita will be $80 per year. To determine the total cost of pollution in a a specific receptor zone, the total population in that zone must be multiplied by the cost per capita. Thus, a damage function for each zone is established based on the population in that zone and the costs of combatting pollution in that zone.

Figure I. Pollution and Cost



For each zone, the slope of the straight line equation is equal to the marginal cost of pollution in that zone. In Figure I the slope is represented by b/a or 20 units/10 units equals 2 units per capita. The marginal cost of pollution is defined as the amount of money saved or spent if the pollution level decreases or increases by 1 $\mu g/m^3$. Thus, if the pollution level increases by 1 $\mu g/m^3$, each individual in the zone will pay an additional \$2 in costs that year. It is a constant for each receptor zone. This means that the benefits that result from any one emitter's reduction in emissions are assumed independent of the benefits that result from any other emitter's reduction. This independence makes it possible to obtain the maximum profit for the entire system by maximizing each emitter's profit separately. It also allows the control of each emitter to be chosen independently of other sources.

After damage functions for each zone are calculated, the benefit function related to the emissions of each emitter are obtained. These are based on the marginal cost of pollution in each zone and the pollution that will be emitted with each alternative available to a specific emitter. The benefits for the two examples cited earlier are shown in the third column of Tables I and II.

As stated previously, the air quality in the entire area is held to be optimal when the net benefit for each emitter is maximized. These maximum net benefits can be determined by subtracting control costs from benefits for each emitter for each alternative control which is available.

These results are shown in the net benefit column for the XYZ Power Plant. (Table I) Note that the net benefit at the last stage of control for this power plant is at the second level of control with emissions of 58 tons/year. Control at this level will have a net benefit of \$162,100 per year.

For the ABC Municipal Incinerator (Table II) the maximum net benefit from control occurs at the maximum control step where emissions are 16 tons/year. Control to this level will result in a net benefit of \$1,359,300 per year.

This analysis was done for each of the emitters considered and the resultant control costs, benefits, and net benefits were summed. The results in the Washington area were:

Total benefits	\$22,073,900
Total control costs	2,833,400
Total net benefits from particulate control	\$19,240,500

The new pollution level in each receptor zone is then determined if such controls were to be adopted by the emitters in the area.

Wilson and Minnotte applied this technique to the Washington, D. C. area, measured only particulate levels and considered only residential soiling damages. However, they feel that this method can be used to establish emission levels for all types of pollutants in all types of areas, if adequate input data (costs of control and damages) is available.

They also state that: "Health effects were not included in this analysis because the economic losses due to soiling justified reductions in the particulate level below the point at which serious health effects have presently been

> shown to occur. This, however, may not be the case when other areas and other pollutants are studied. In any case, health effects should determine the maximum acceptable air quality level and economic effects should be used to determine if levels below this would be a benefit to the community."

When this type of analysis is used to determine the optimum air quality level, a selective type of regulation scheme would be required because an independent emission level is determined for each emitter.

It must also be remembered that this type of cost-benefit analysis is considering the net benefit to THE ENTIRE COMMUNITY. It does not necessarily follow that the net benefit to *each* individual emitter and receptor in the community is maximized. Under some control methods the cost is entirely borne by the receptor and the benefit is to the emitter, whereas under others the emitter bears the cost and the receptor receives the benefit. However, in the Washington, D. C. examples given, even if the control costs of the selected alternatives were passed on to the consumer, the benefit would still outweigh the costs.

Certainly, one of the most controversial aspects of the cost-benefit approach is the determination of the damage functions. A number of studies that attempt to measure the costs of air pollution will now be reviewed. Such studies can possibly serve as guidelines for determining what are the costs of air pollution to the residents of an Air Quality Region.

Steubenville Study

Michelson and Tourn (5) performed a study to estimate the economic effects of air pollution in the Upper Ohio River Valley in 1960. Their study was a comparison study between Steubenville, Ohio and Uniontown, Pennsylvania. At that time Uniontown's air was relatively clean when compared with the air in Steubenville. They stress the importance of comparing two communities which are similar in as many aspects as possible, so that the level of air pollution is the only variable. Some examples of socioeconomic variables that should be controlled are: number of residents, number of households, topography, occupational distribution of the population, income levels, native and foreign born, length of residence in same house, and others. Census data provides much of this information. Although the two cities were reasonably well matched there were differences. Two of the most important differences were topography and the occupational distribution of the population.

The study covered only the extra costs in maintaining:

(a) exterior walls and windows of frame houses;
(b) the interior walls and windows, curtains and drapes and rugs and upholstery;
(c) laundry and cleaning costs of men's shirts and suits, women's dresses, and children's outerwear; and
(d) women's hair and face care.

Three types of data were collected in each of the above categories: 1) The frequency with which various functions that might be directly influenced by air pollution were performed; for example, the average waiting period before repainting the exterior of frame houses. 2) The proportion of the population to which various frequencies were applicable; for example, the number of families owning homes with wood exterior walls. 3) Factors that might influence either the frequency of an activity or the number of families that might perform the activity, so that comparison groups could be matched to some degree; for example, household income, educational level, and so on. A separate questionnaire of 25 to 75 direct or indirect questions was used for each of the categories. The bulk of the questionnaires were distributed by mail. The sample families were selected from the phone directory and a city directory listing private home owners by street and dwelling. Citywide programs were used to raise the rate of response. These included newspaper and radio progress reports and telephone followup calls.

Local market prices were used to determine the costs of cleaning supplies and household services. The "do-it-yourselfer" and housewives' labor costs were not counted as being of any economic value. Thus, there was wide variation in the cost of pollution between those who hired outside labor for cleaning, painting, and other maintenance and those who did not. The study did not take into account the possibility that the standards of cleanliness might be different in the two communities and between income groups within the communities.

Michelson, in a later report (3) mentions other items that could be included in any future studies to determine the costs of living in polluted air:

(a) maintenance of masonry and of metal parts of buildings (screens, gutters, etc.) and costs of more frequent replacements;
(b) maintenance of linens, leather, rubber, and paper articles in the home, and costs of more frequent replacements;
(c) laundering of all other clothing articles, and costs of more frequent replacement due to corrosive attack and more frequent and harsher cleaning required;
(d) car maintenance (washing, more frequent replacement of air filters and tires);
(e) extra lighting costs due to darkened skies;
(f) agricultural losses -- home ornamental plants, higher costs of foods due to pollution-damaged crops and animals;
(g) lowered property values;
(h) higher prices generally, due to increased maintenance and cleaning costs in stores and offices;
(i) costs of health effects, of the direct kind in payment for medical care and drugs, in lost time at work, and in lowered productivity because of chronic health effects;
(j) loss of esthetic values;
(k) costs of more frequent cleaning and maintenance of public facilities -- streets, public buildings, parks, etc. -- all reflected in higher taxes if these facilities are given proper care;

(l) transportation delays (car and air travel) due to air-pollution-caused fog; and
(m) interior maintenance of offices and store operation and maintenance (this was included in the original study, but because of the heterogeneity of establishments and the small number of respondents in each category, this factor had to be eliminated.)

If it is decided to include any or all of these factors in the damage function, much of the data can be most effectively collected by the members of the community that is affected by air pollution.

Health Costs

Extensive studies have been conducted in Nashville, Tennessee, (1,9) and Buffalo, New York, (8) to determine the relationship of air pollution and human health. In these studies the area under consideration was divided into 3 or 4 levels of pollution and the economic status of the population was divided into 3 or 5 levels. It is very important that socioeconomic variables be controlled in such studies because mortality rates are correlated with economic status. Mortality data can be obtained from the County Health Department. The death certificate may provide data concerning age, sex, race, marital status, residence at the time of death, and cause of death. Additional data that is important might be obtained through interviews of the deceased's family. This includes such data as usual and last occupation, tobacco use, residential mobility and dietary habits.

Lave and Seskin (2) discuss the importance of morbidity data when investigating the effects of pollution. Employee absence rates may correlate with air pollution episodes. However, there are many other factors (such as day of the week and season) which also effect employee absences.

Considerable conclusive evidence of studies relating air pollution levels with mortality and morbidity are presented by Lave and Seskin. The next step is that of translating the increased sickness and death into dollar units. The relevant question is: How much is society willing to pay to improve health? Lave and Seskin, based on work by Rice (6), state that: "It has become common practice to estimate what society is willing to pay by totaling the amount that is spent on medical care and the value of earnings "foregone" as a result of the disability or death." Thus, health costs of air pollution would include expenditures for hospital and nursing home care and for services of physicians, dentists, and members of other health professions. Indirect costs must be estimated to measure the losses to the nation's economy caused by illness, disability, and premature death. These costs are calculated in terms of the earnings foregone by those who are sick, disabled, or prematurely dead.

Estimates of health costs of air pollution can then be made by determining the amount of money spent on health in the community and the effects of reducing air pollution on the health of the community. For example, the studies cited by Lave and Seskin indicate that mortality from bronchitis would be reduced by about 50% if air pollution was abated by about 50%. Thus, a similar reduction in the cost would also occur.

In summary, the literature provides considerable evidence that polluted air is costly to the people who live in it. However, before the citizens of a community can rationally decide what level of pollution is acceptable to them, costs of control and dollar benefits of control (i.e., damage functions) must be determined for their community. Once such data is combined into a cost-benefit model and presented to the community, decisions can be made concerning the community's air environment.

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5. ________________, and Tourin, Boris, "Comparative Method for Studying Costs of Air Pollution," Public Health Reports, Vol. 81, No. 6, June, 1966, pp 505-511.

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APPENDIX D

Tabulated Responses
to
April 16-17, 1975 Workshop Evaluation

TABULATION OF RESPONSES

WORKSHOP ON AIR QUALITY IN

THE STEUBENVILLE-WEIRTON AREA

BASICS

1. In each of the areas covered the material was:

	Too Technical	Appropriate	Too Basic	Of No Interest To Me
a) Chemistry	( ) 12	( ) 16	( ) 2	( )
b) Meteorology	( ) 4	( ) 22	( ) 3	( )
c) Measuring Devices	( )	( ) 27	( ) 3	( )
d) Control Equipment	( )	( ) 25	( ) 4	( )

2. This session provided me with new information.

Strongly Agree	Agree	Mixed Feelings	Disagree	Strongly Disagree	No Opinion
( ) 5	( ) 20	( ) 5	( )	( )	( ) 1

3. I gained new understandings of air pollution in this session.

Strongly Disagree	Disagree	Mixed Feelings	Agree	Strongly Agree	No Opinion
( )	( )	( )	( )	( )	( )
2	1	6	16	4	2

4. Please check the topics you would be interested in studying in more detail (if any).

12 ( ) Chemistry of air pollution
8 ( ) Meteorology
12 ( ) Measuring devices of pollutants
19 ( ) Air pollution control equipment

5. The reading material distributed during this session was useful.

Strongly Agree	Agree	Mixed Feelings	Disagree	Strongly Disagree	No Opinion
( )	( )	( )	( )	( )	( )
6	19	2			2

HEALTH

1. This session provided me with new information.

Strongly Agree	Agree	Mixed Feelings	Disagree	Strongly Disagree	No Opinion
( ) 7	( ) 11	( ) 7	( )	( ) 1	( ) 2

2. I gained a new understanding of the relationship of health and air pollution.

Strongly Disagree	Disagree	Mixed Feelings	Agree	Strongly Agree	No Opinion
( )	( ) 6	( ) 6	( ) 10	( ) 4	( ) 2

3. Please check the topics you would be interested in studying in more detail.

20 ( ) the local incidence of respiratory and heart diseases
17 ( ) the impact of air quality on infants and children

ECONOMICS

1. In each of these areas the material was:

	Too Technical	Appropriate	Too Basic	Of No Interest To Me
(a) Health costs	( ) 1	( ) 18	( ) 3	( )
(b) Control Costs	( ) 2	( ) 17	( ) 3	( )

2. This session provided me with new information.

Strongly Agree	Agree	Mixed Feelings	Disagree	Strongly Disagree	No Opinion
( ) 5	( ) 11	( ) 3	( ) 3	( )	( )

3. I gained a new understanding of the economic issues involved in the air pollution problem.

Strongly Disagree	Disagree	Mixed Feelings	Agree	Strongly Agree	No Opinion
( )	( ) 2	( ) 5	( ) 1	( ) 2	( ) 1

4. I think the material in this session presented both aspects of the economic issue fairly.

Strongly Agree	Agree	Mixed Feelings	Disagree	Strongly Disagree	No Opinion
( ) 2	( ) 11	( ) 4	( ) 4	( ) 1	( )

5. In my opinion the real issues involved in the economics of air pollution were addressed.

Strongly Disagree	Disagree	Mixed Feelings	Agree	Strongly Agree	No Opinion
( )	( ) 4	( ) 6	( ) 9	( ) 1	( )

6. I would be interested in investigating the subject of economics in the following areas:

19 ( ) local health costs
18 ( ) local control costs to industry
12 ( ) materials damage costs
9 ( ) vegetation damage costs

7. The paper provided by the Workshop Staff entitled, "A Cost-Benefit Approach to a Community's Air Quality," was useful to me.

Strongly Agree	Agree	Mixed Feelings	Disagree	Strongly Disagree	No Opinion
( ) 2	( ) 18	( ) 1	( )	( )	( )

REGULATIONS

1. This information was useful to me.

Strongly Agree	Agree	Mixed Feelings	Disagree	Strongly Disagree	No Opinion
( ) 3	( ) 15	( ) 3	( ) 1	( )	( )

2. I understand the authority of each agency better than I previously did.

Strongly Disagree	Disagree	Mixed Feelings	Agree	Strongly Agree	No Opinion
( )	( )	( ) 4	( ) 14	( ) 4	( ) 1

3. This session made me more aware of the citizen's role in the regulatory process.

Strongly Agree	Agree	Mixed Feelings	Disagree	Strongly Disagree	No Opinion
( )	( ) 13	( ) 3	( ) 3	( ) 2	( ) 2

FUTURE WORKSHOPS

1. Do you think more members of the community would attend:

15 ( ) an evening session
10 ( ) a Saturday session
17 ( ) a one-day session
7 ( ) probably would not attend any session

2. Do you think workshop speakers should be drawn from:

1 ( ) the local area
1 ( ) outside experts
29 ( ) both

3. Please check the format(s) you feel is most useful:

12 ( ) lectures
10 ( ) panels
16 ( ) discussion groups

SUMMARY OF RESPONSES

I. Suggestions of additional topics of interest to people:

   A. Approximately one-third of the respondents mention the desire for more information on local problems:

      1. Area doctors and Health Department people to speak on the health related problems;

      2. Air pollution control equipment as related to local emission sources.

      3. Point sources and emissions in the area.

      4. Local abatement and damage costs.

   B. Topics of interest to a few people:

      1. What can an individual do to improve air quality?

      2. Why not really wade into the AEP-EPA controversy?

      3. Legal matters and air pollution need discussing.

      4. How are indexes calculated? How are the levels of pollutants determined? What levels indicate the need to call an alert?

      5. What are the practical facts concerning the economics of an industry?

      6. Do the local residents or all consumers of the product pay for the costs of clean air?

      7. What are the politics of pollution? Why do some communities clean up their environment and others do not?

      8. What is the relationship of cigarette smoke as an additional health hazard in polluted areas to smokers and non-smokers?

      9. How does the problem of open burning contribute to air pollution?

Although almost everyone wants outside speakers, a couple people specifically make the comment that outside speakers should be well informed about the local problem.

II. Criticisms of the Workshop:

A. Outdated data (particularly in the area of economics) was mentioned by several people as a problem in estimating the real costs of pollution abatement or damage costs.

B. Several people mentioned the difficulty in hearing some of the speakers.

C. Some speakers expressed too much personal opinion.

D. There were a few negative comments about Mr. Engdahl's and Dr. Griffin's presentations.

E. The overhead projector was overused and some of the data presented in this manner was unreadable.

APPENDIX E

July 29-30, 1975 Workshop

Workshop Program
Materials Available
Staff Compiled Materials

STEUBENVILLE-WEIRTON AIR QUALITY WORKSHOP

Millsop Community Center
Weirton, West Virginia

Session I
Tuesday, July 29, 9:00 A.M.

THE LOCAL SITUATION

Resource People: Pat DeLuca, North Ohio Valley Air Authority
Steve Smallwood, West Virginia Air Pollution Control Commission

- What are the sources of pollutants?
- What are the quantities of various pollutants emitted at each source?
- Where are the sampling sites in relation to the emitters?
- What is involved in a permit application?
- What is the status of the emitters permits?

Session II
Tuesday, July 29, 1:00 P.M.

THE LEGAL PROCESS AND AIR QUALITY

Resource People: Brent English, Air Pollution Study Group, Inc.
Ed Carter, Central Ohio Lung Association

- What are the legal processes available to citizens to achieve better air quality?
- What legal precedent has been set?
- What approaches outside the legal process are available?

Session III
Wednesday, July 30, 9:00 A.M.

THE COST OF POOR AIR QUALITY TO THE CITIZEN

- What are personal symptoms of health-related effects from poor air quality?
- How can health effects be measured?
- What other costs of poor air quality should the citizen be aware of?
- What is the Steubenville-Weirton area's relative economic standing?

Materials Available at July Workshop

"A Citizen's Guide to Clean Air," The Conservation Foundation, January, 1972, 95 pages.

"Citizen Action and the Administrative Process." Presented at the Environmental Leadership Workshop, March 22-23, 1975, by Barry H. Smith.

"Citizen's Guide to the Ohio Environmental Protection Agency." Compiled by members of The Columbus Bar Association Environmental Law Committee, 42 pages.

"Citizen Role in Implementation of Clean Air Standards," U. S. Environmental Protection Agency, October, 1971, 11 pages.

"Environment Midwest," July, 1975, Region V, U. S. Environmental Protection Agency.

"Litigating for Air Pollution Control: Guidelines for Lung Associations," American Lung Association, November, 1974, 16 pages.

"The Economic Impact of Environmental Programs," Executive Office of the President, Council on Environmental Quality, November, 1974.

Staff Compiled Materials:

"Checklist of Air Pollution Effects"
"Selected Socioeconomic and Mortality Factors for the Area"
"Social and Economic Characteristics from U. S. Census"
"Summary of Buffalo Air Pollution Study"
"Summary of Nashville Air Pollution Study"

A CHECKLIST OF POSSIBLE AIR POLLUTION EFFECTS

Health Effects That May Be Attributable to Air Pollution:

1. Frequent and/or persistent coughing;
2. Minor sore throat or other throat irritation;
3. Difficulty breathing or "breathlessness";
4. Chest constriction;
5. Burning or smarting of the eyes;
6. Excessive tearing;
7. Apathy or lack of energy;
8. Headache;
9. Reoccurring colds or respiratory infections.

Materials Damage and Soiling Effects That May Be Attributable to Air Pollution:

1. Corrosion of metal surfaces such as siding, screens, door and window frames, drainpipes, and gutters;
2. Replacement of power line hardware or other metal structures more often than in other areas;
3. Damage to other building materials such as limestone, marble, roofing slate, or mortar;
4. Softened paint on exterior surfaces requiring frequent repainting;
5. Premature deterioration of cotton, rayon, or nylon garments, and nylon hose;
6. Brittle or discolored paper;
7. Frequent laundering or drycleaning of curtains, drapes, and garments;
8. Furnace air filters need changing more than twice a year.

Other Effects:

1. Need for an electrostatic precipitator in homes to filter the outside air;
2. Burning of lights during daylight hours because of darkened skies;
3. Closing of airports because of poor visibility;
4. Increased expenditures by town governments for street maintanence;
5. Leaf damage and/or death of plants and trees;
6. Decreased property values in areas that experience high levels of pollution.

2.4–5 ADDED COSTS OF LIVING IN DIRTY ENVIRONMENT

Downtown Steubenville, Ohio, 383 $\mu g/m^3$
Versus Uniontown, Pa., 115 $\mu g/m^3$
Particulates for 28 Activities, 1960

	Income group[a]	Extra cost per family Do-it-yourself	 Non-do-it-yourself
Inside maintenance	A	$ 29	$162
	B	44	227
Outside maintenance	A	21	49
	B	337	368
Laundry and cleaning	A	27	79
	B	129	186
Hair and facial care		9	48
Totals, per family			
In private homes	A	86	338
	B	519	829
In apartments (no inside painting or decorating, no outside maintenance)	A	47	263
	B	158	423

[a] A – Annual income under $8 000.
B – Annual income, $8 000 or more.

Source: *Interstate Air Pollution Study*, U.S. Department of Health, Education, and Welfare, Robert A. Taft Sanitary Engineering Center, Cincinnati, O., 1966.

Source: Handbook of Environmental Control. Volume 1: Air Pollution. Cleveland: CRC Press. 1972.

2.3–11 SENSITIVITY OF SELECTED PLANTS TO OZONE

Crops[a]

- Alfalfa
  - *Medicago sativa* L.
- Barley
  - *Hordeum vulgare* L.
- Bean
  - *Phaseolus vulgaris* L.
- Clover, red
  - *Trifolium pratense* L.
- Corn, sweet
  - *Zea mays* L.
- Grass, bent
  - *Agrostis palustris* Huds.
- Grass, brome
  - *Bromus inermis* Leyss.
- Grass, crab
  - *Digitaria sanguinalis* L.
- Grass, orchard
  - *Dactylis glomerata* L.
- Muskmelon
  - *Cucumis melo* L.
- Oat
  - *Avena sativa* L.
- Onion
  - *Allium cepa* L.
- Peanut
  - *Arachis hypogaea* L.
- Potato
  - *Solanum tuberosum* L.
- Radish
  - *Raphanus sativus* L.
- Rye
  - *Secale cereale* L.
- Spinach
  - *Spinacea oleracea* L.
- Tobacco
  - *Nicotiana tabacum* L.
- Tomato
  - *Lycopersicon esculentum* Mill.
- Wheat
  - *Triticum aestivum* L.

Trees, Shrubs, and Ornamentals

- Alder
  - *Alnus* species
- Apple, crab
  - *Malus baccata* Borkh.
- Aspen, quaking
  - *Populus tremuloides* Michx.
- Box elder
  - *Acer negundo* L.
- Bridalwreath
  - *Spiraea prunifolia* Sieb. & Zucc.
- Carnation
  - *Dianthus caryophyllus* L.
- Catalpa
  - *Catalpa speciosa* Warder
- Chrysanthemum
  - *Chrysanthemum* species
- Grape
  - *Vitis vinifera* L.
- Lilac
  - *Syringa vulgaris* L.
- Locust, honey
  - *Gleditsia triacanthos* L.
- Maple, silver
  - *Acer saccharinum* L.
- Oak, gambel
  - *Quercus gambelii*
- Petunia
  - *Petunia hybrida* Vilm.
- Pine, eastern white
  - *Pinus strobus* L.
- Pine, ponderosa
  - *Pinus ponderosa* Laws.
- Privet
  - *Ligustrum vulgare* L.
- Snowberry
  - *Symphoricarpos albus* Blake
- Sycamore
  - *Platanus occidentalis* L.
- Weeping willow
  - *Salix babylonica* L.

[a] Generally, the crops listed are more sensitive than the trees and shrubs.

Source: *Recognition of Air Pollution Injury to Vegetation: A Pictorial Atlas*, J.S. Jacobson and A.C. Hill, Eds., Air Pollution Control Association and National Air Pollution Control Association, Pittsburgh, Pa., 1970.

Source: Handbook of Environmental Control. Volume 1: Air Pollution. Cleveland: CRC Press. 1972.

2.3–15 SENSITIVITY OF SELECTED PLANTS TO SULFUR DIOXIDE

Crops

Alfalfa
Medicago sativa L.
Barley
Hordeum vulgare L.
Bean, field
Phaseolus species
Clover
Melilotus and Trifolium species
Cotton
Gossypium species
Oat
Avena sativa L.
Rye
Secale cereale L.
Safflower
Carthamus tinctorius L.
Soybean
Glycine max Merr.
Wheat
Triticum species

Garden Flowers

Aster
Aster bigelovii
Bachelor's button
Centarea cyanus L.
Cosmos
Cosmos bipinnatus Cau.
Four o'clock
Mirabilis jalapa L.
Morning glory
Ipomoea purpurea Roth
Sweet pea
Lathyrus odoratus L.
Verbena
Verbena canadensis Brit.
Violet
Viola species
Zinnia
Zinnia elegans Lorenz

Trees

Apple
Malus species
Birch
Betula species
Catalpa
Catalpa speciosa Warder
Elm, American
Ulmus americana L.
Larch
Larix species
Mulberry
Morus microphylla Buckl.
Pear
Pyrus communis L.
Pine, eastern white
Pinus strobus L.
Pine, ponderosa
Pinus ponderosa Laws
Poplar, lombardy
Populus nigra L.

Garden Plants

Bean
Phaseolus vulgaris L.
Beet, table
Beta vulgaris L.
Broccoli
Brassica oleracea var. *botrytis* L.
Brussels sprouts
Brassica oleracea var. *gemmifera* L.
Carrot
Daucus carota var. *sativa* L.
Endive
Cichorium endivia L.
Lettuce
Lactuca sativa L.
Okra
Hibiscus esculentus L.
Pepper (bell, chili)
Capsicum frutescens L.
Potato, sweet
Ipomoea batatas Lam.
Pumpkin
Cucurbita pepo L.
Radish
Raphanus sativus L.
Rhubarb
Rheum rhaponticum L.
Spinach
Spinacea oleracea L.
Squash
Cucurbita maxima Duchesne
Swiss chard
Beta vulgaris var. *cicla*
Turnip
Brassica rapa L.

Weeds

Bindweed
Convolvulus arvensis L.
Buckwheat
Fagopyrum sagittatum Gilib.
Careless weed
Amaranthus palmeri S. Wats.
Dock, curly
Rumex crispus L.
Fleabane
Erigeron canadensis L.
Lettuce, prickly
Lactuca serriola L.
Mallow
Malva parviflora
Plantain
Plantago major L.
Ragweed
Ambrosia artemisiifolia L.
Sunflower
Helianthus species
Velvet-weed
Gaura parviflora Dougl.

Source: *Recognition of Air Pollution Injury to Vegetation: A Pictorial Atlas*, J.S. Jacobson and A.C. Hill, Eds., Air Pollution Control Association and National Air Pollution Control Association, Pittsburgh, Pa., 1970.

Source: Handbook of Environmental Control. Volume 1: Air Pollution.
Cleveland: CRC Press. 1972.

MORTALITY DATA

Deaths due to selected causes, 1970
Given as number of deaths per 100,000 population

CAUSE	COUNTY													
	Columbiana County, Ohio	Jefferson County, Ohio	Belmont County, Ohio	Monroe County, Ohio	Brooke County, W.Va.	Hancock County, W.Va.	Marshall County, W.Va.	Ohio County, W.Va.	Monongahela County, W.Va.	Cuyahoga County, Ohio	Coschocton County, Ohio	Hamilton County, Ohio	Washington County, Ohio	Stark County, Ohio
Tuberculosis	0.92	4.15	0	0	3.36	5.03	0	7.78	1.56	2.38	0	2.59	5.24	1.34
Malignant Neoplasms of Respiratory System	27.69	41.58	53.61	12.7	40.42	32.7	55.85	71.65	47.08	41.94	35.83	43.72	31.49	31.70
Heart Diseases	1656.35	1561.43	1841.71	1569.33	1367.69	1353.48	1601.13	1743.05	1279.14	1279.71	1584.82	1284.10	1355.83	1299.79
Influenza and Pneumonia	27.69	21.83	33.66	63.53	20.21	15.09	34.57	35.82	37.66	25.62	65.69	34.09	38.48	29.55
Bronchitis, Asthma and Emphysema	26.77	27.02	18.70	-	16.84	10.06	29.25	31.75	14.12	16.32	26.87	15.8	24.48	13.97

Sources: Vital Statistics of the United States, 1970. Volume II. Mortality, Part B. Table 7-9.
U. S. Dept. of Health, Education & Welfare, Public Health Service.

1970 Census of the Population. Volume I. Table 35.

MORTALITY DATA

Deaths in selected SMSA's by age group, 1970

Given as number of deaths per 100,000 population

Age Group	SMSA				
	Canton	Cincinnati	Cleveland	Steubenville-Weirton	Wheeling
45 - 54 years	611.52	781.85	743.06	865.38	885.95
55 - 64 years	1437.30	1807.15	1714.13	1734.66	1741.39
65 and over	6140.13	6336.88	8229.84	6370.41	7184.03

Sources: Vital Statistics of the United States, 1970. Volume II. Mortality, Part B. Table 7-4. U. S. Dept. of Health, Education and Welfare.

1970 Census of the Population. Volume I. Table 138.

% of Population in Each of the Following Age Groups in 1970

COUNTY	Under 1 year	1-19 yrs.	20-29 yrs.	30-39 yrs.	40-49 yrs.	50-59 yrs.	60-69 yrs.	70 and over yrs.
Columbiana	1.61	36.09	12.16	10.41	12.67	11.46	8.27	7.37
Jefferson	1.45	35.39	11.80	10.51	13.09	12.50	8.47	6.77
Belmont	1.40	33.51	11.20	9.79	12.70	13.15	9.40	8.84
Monroe	1.88	36.70	12.02	10.73	11.11	10.19	8.41	8.96
Brooke	1.80	35.49	12.81	11.48	13.22	11.48	7.72	6.00
Hancock	1.58	36.48	11.87	11.52	13.71	12.12	7.52	5.21
Marshall	0.85	34.84	13.33	11.02	12.95	11.62	8.03	7.36
Ohio (W.Va.)	1.42	32.62	13.08	9.12	12.48	12.40	10.01	8.87
Monongahela	1.65	33.50	23.44	9.16	10.24	9.13	6.73	6.15
Cuyahoga	1.65	34.72	13.98	10.64	12.86	11.87	7.35	6.44
Coshocton	1.61	35.45	11.84	11.08	12.43	11.19	8.56	7.85
Hamilton	1.78	36.42	14.36	10.93	11.76	10.17	7.93	6.66
Washington	1.68	36.89	13.97	11.30	11.70	9.70	7.30	7.46
Stark	1.70	36.42	13.57	10.88	12.76	10.74	7.37	6.55

Data Source: 1970 Census of the Population, Vol. 1. Characteristics of the Population. Part 37. Ohio. Part 50. West Virginia. Tables 35, 119, 120, 124. U. S. Dept. of Commerce, Bureau of the Census, Issued 1973.

COMPARISON OF SOME SOCIO-ECONOMIC FACTORS

FACTOR	COUNTY													
	Columbiana County, Ohio	Jefferson County, Ohio	Belmont County, Ohio	Monroe County, Ohio	Brooke County, W.Va.	Hancock County, W.Va.	Marshall County, W.Va.	Ohio County, W.Va.	Monongahela County, W.Va.	Cuyahoga County, Ohio	Coschocton County, Ohio	Hamilton County, Ohio	Washington County, Ohio	Stark County, Ohio
Residential Mobility														
% of population in same home in 1965 and 1970	61.2	62.6	65.7	66.7	64.2	66.2	58.6	62.1	50.1	55.2	58.5	51.9	57.6	57.4
% of population in same county, different home, 1965 and 1970	23.0	25.5	22.9	17.8	19.9	19.5	21.5	19.7	15.6	29.5	27.6	30.3	23.0	27.2
TOTAL % OF POPULATION LIVING IN THE SAME COUNTY, 1965 and 1970	84.2	88.1	88.6	84.5	84.1	85.7	80.1	81.8	65.7	84.7	86.1	82.2	80.6	84.6
Median Years School Completed														
Male, 25 years of age and over	11.3	11.1	11.0	11.3	10.9	11.1	10.4	11.7	12.1	12.1	12.0	12.1	12.1	12.0
Female, 25 years of age and over	11.8	11.7	11.3	11.1	11.3	11.4	11.0	11.6	12.1	12.1	12.1	12.0	12.1	12.1
Income														
Median family income	9,032	9,347	8,455	7,630	9,296	10,380	8,492	8,770	7,758	11,309	8,343	10,486	8,568	10,249
Mean family income	9,814	10,066	9,008	7,876	9,873	10,993	8,970	10,233	8,763	12,933	8,973	12,061	9,113	11,292
% of families with income less than $4,000	13.4	13.9	16.0	24.7	13.5	10.3	15.5	16.0	20.5	10.9	16.6	11.9	15.7	9.6
% with income of 4,000 - 5,999	11.0	9.8	12.2	14.0	10.0	8.1	12.2	11.9	15.0	7.0	12.7	8.8	12.8	7.9
6,000 - 7,999	15.8	13.8	17.5	14.3	15.2	12.7	17.0	15.7	16.7	9.5	17.6	11.5	16.5	13.1
8,000 - 9,999	19.3	18.5	17.5	18.6	18.5	15.4	20.0	16.9	15.3	13.4	16.9	14.5	18.1	17.4
10,000 - 11,999	14.3	16.7	14.6	10.2	16.2	18.5	13.3	12.9	10.7	14.1	13.2	13.8	13.1	16.4
12,000 - 14,999	13.5	13.5	12.2	9.4	13.7	17.2	11.2	12.5	9.8	16.9	11.7	15.4	11.7	16.6
15,000 - 24,999	10.4	11.5	8.4	7.8	10.4	15.2	9.5	10.3	10.0	21.6	9.3	18.2	10.5	15.6
25,000 - 49,999	1.9	1.6	1.3	1.0	2.2	2.2	1.1	2.9	1.9	5.3	2.0	4.8	1.4	2.9
50,000 or more	.4	.5	.2	-	.3	.4	.1	1.1	.3	1.3	.1	1.1	.2	.5

Table 43. Summary of Social Characteristics by Counties: 1970

[Data based on sample, see text. For minimum base for derived figures (percent, median, etc.) and meaning of symbols, see text]

Counties	Total population			Native population—Percent residing in State of birth	Persons 5 years and over—Percent migrant	Children in elementary school—Percent in private school	Persons 14 to 17 years—Percent in school	Persons 25 years and over—Median school years completed	Married couples—Percent without own household	Families—Percent with own children under 6 years	Persons under 18 years—Percent living with both parents	Women 35 to 44 years—Cumulative fertility rate[1]
	Number	Percent foreign born	Percent native of foreign or mixed parentage									
The State	**10 650 983**	**3.0**	**9.3**	**71.6**	**13.6**	**14.3**	**94.4**	**12.1**	**1.1**	**26.8**	**85.4**	**3 000**
Adams	18 957	0.2	0.4	79.6	14.2	0.5	92.2	9.0	1.9	23.3	87.2	3 289
Allen	111 144	1.3	3.9	79.3	11.5	15.4	94.7	12.1	0.7	26.9	86.7	3 350
Ashland	43 303	0.9	3.7	81.8	15.9	3.2	93.8	12.2	1.2	25.6	90.1	3 191
Ashtabula	98 237	3.0	13.0	72.2	11.6	8.8	96.9	12.0	1.2	26.6	87.5	3 255
Athens	54 889	1.8	4.0	73.5	30.3	3.0	91.8	12.2	1.1	26.1	84.0	2 945
Auglaize	38 602	0.4	2.5	86.6	11.9	7.2	93.8	12.1	1.1	28.2	91.5	3 437
Belmont	80 917	3.3	13.9	76.6	8.7	12.6	97.2	11.2	1.2	22.6	88.4	2 979
Brown	26 635	0.2	1.3	74.9	18.0	4.8	90.6	10.8	1.1	28.7	86.3	3 439
Butler	226 207	1.2	3.9	64.4	17.2	9.0	92.3	11.7	1.2	27.0	86.4	2 994
Carroll	21 579	1.2	6.1	82.7	19.6	5.3	90.7	11.7	1.7	26.7	87.6	3 388
Champaign	30 491	0.4	1.9	84.4	14.7	2.7	93.8	12.1	1.0	24.3	89.0	3 285
Clark	156 026	1.0	3.6	74.2	16.4	7.4	94.0	12.0	1.0	27.2	85.3	2 957
Clermont	95 725	0.8	3.0	70.0	18.3	7.2	91.9	11.2	1.4	30.2	88.7	3 424
Clinton	31 464	0.6	2.1	78.6	18.4	0.8	94.4	12.1	0.8	27.1	84.9	3 107
Columbiana	108 310	1.9	7.9	76.5	11.0	7.0	93.4	11.6	1.1	23.9	87.7	3 065
Coshocton	33 486	0.5	2.5	85.0	11.1	5.4	91.0	12.0	1.0	23.1	87.6	2 908
Crawford	50 364	0.8	4.2	78.6	13.6	9.8	91.6	12.1	0.9	27.4	87.2	3 015
Cuyahoga	1 721 298	7.5	19.4	68.0	8.9	23.5	95.2	12.1	1.2	24.8	81.9	2 776
Darke	49 141	0.4	1.6	80.5	13.2	2.2	90.7	12.0	0.8	26.6	90.5	3 188
Defiance	36 949	1.0	5.7	75.2	18.5	8.3	91.4	12.1	0.7	31.6	90.3	3 446
Delaware	42 908	1.1	3.2	74.4	27.3	5.4	93.3	12.3	1.0	25.7	86.4	3 089
Erie	75 909	2.0	8.6	72.9	15.4	12.4	91.2	12.2	0.9	28.8	87.0	3 179
Fairfield	73 301	0.4	2.4	82.9	16.4	8.1	93.6	12.1	1.5	27.5	85.5	3 127
Fayette	25 461	0.4	1.3	87.2	17.9	-	94.7	11.6	0.7	23.9	84.7	2 957
Franklin	833 249	2.0	5.6	68.0	17.2	11.1	94.4	12.3	0.9	28.6	82.2	2 823
Fulton	33 071	1.4	6.0	79.6	14.9	6.7	91.7	12.2	0.8	29.2	90.7	3 570
Gallia	25 239	0.8	1.9	70.6	15.3	0.2	83.2	10.0	1.6	25.5	81.9	3 033
Geauga	62 977	3.2	14.7	75.3	24.2	17.0	94.4	12.3	1.2	30.6	92.7	3 118
Greene	125 057	1.5	4.5	61.4	28.4	8.3	95.1	12.3	0.8	29.4	88.0	2 863
Guernsey	37 665	1.4	5.3	80.2	15.4	5.1	89.9	11.5	1.4	25.8	84.6	3 097
Hamilton	924 009	2.3	6.8	66.6	11.5	25.5	93.7	12.0	0.9	27.4	82.5	2 959
Hancock	61 217	0.7	4.0	80.3	17.4	9.8	97.7	12.3	0.6	27.0	91.0	3 090
Hardin	30 813	0.9	2.5	83.7	18.2	3.9	88.6	12.1	0.6	25.7	89.4	3 360
Harrison	17 013	1.0	6.0	82.7	13.6	1.8	92.5	11.5	2.1	23.9	82.8	3 016
Henry	27 058	1.0	7.1	85.6	13.0	11.5	95.7	12.1	0.8	30.1	90.8	3 351
Highland	28 996	0.4	0.8	86.4	14.9	0.5	92.5	11.5	1.1	24.7	84.5	2 871
Hocking	20 322	0.2	1.9	89.6	14.7	2.1	91.1	11.4	1.2	25.7	85.7	3 005
Holmes	23 024	0.5	1.8	88.8	11.7	17.7	74.0	9.1	0.6	36.1	93.7	3 712
Huron	49 587	1.4	5.9	78.2	16.4	14.0	93.1	12.1	1.1	28.9	88.9	3 548
Jackson	27 174	0.1	0.9	84.4	14.6	0.1	88.3	10.5	1.8	22.8	83.9	3 347
Jefferson	96 193	3.9	15.4	76.1	7.2	14.8	93.9	11.4	1.7	22.8	86.6	2 949
Knox	41 795	1.1	3.3	77.6	17.2	7.4	94.8	12.2	1.1	25.8	84.8	2 903
Lake	197 200	4.1	16.6	71.0	20.5	18.1	96.4	12.2	1.0	30.9	91.1	2 972
Lawrence	56 868	0.3	1.1	66.5	11.6	2.2	92.9	11.1	1.1	27.8	84.3	2 991
Licking	107 799	0.8	3.2	78.0	15.9	5.3	91.6	12.1	1.0	26.5	86.7	3 151
Logan	35 072	0.3	1.9	85.4	14.8	0.6	90.0	12.1	1.2	25.1	86.6	3 260
Lorain	256 843	3.6	13.4	67.4	13.7	14.4	95.9	12.1	1.4	30.5	88.6	3 205
Lucas	484 368	3.0	11.7	73.5	9.6	21.3	96.4	12.1	1.0	26.4	83.3	3 122
Madison	28 318	0.5	1.8	80.7	24.6	8.1	90.3	11.5	1.2	27.5	85.9	3 281
Mahoning	303 424	5.3	18.9	72.5	8.7	23.8	96.5	12.0	1.8	22.7	85.6	2 855
Marion	64 724	1.0	2.7	78.6	15.0	3.9	91.7	12.1	1.0	27.6	86.1	3 172
Medina	82 717	2.3	10.1	72.2	24.6	7.9	96.2	12.2	1.3	29.4	91.5	3 114
Meigs	19 799	0.3	1.4	69.3	12.9	0.3	84.9	10.5	1.0	23.9	84.1	2 952
Mercer	35 265	0.4	3.1	85.3	10.7	8.3	92.8	11.8	0.8	30.2	92.1	4 076
Miami	84 342	0.7	2.6	79.0	16.0	5.2	97.4	12.1	1.1	27.3	87.6	2 977
Monroe	15 739	0.1	2.1	77.9	12.3	2.5	96.3	11.2	0.7	28.7	88.8	3 275
Montgomery	606 148	1.7	5.2	62.4	15.2	12.5	95.0	12.2	0.9	27.3	83.5	2 815
Morgan	12 375	0.3	2.0	87.7	14.6	-	86.7	11.7	2.2	26.8	90.6	3 449
Morrow	21 348	0.3	2.1	79.3	17.4	1.0	93.8	12.1	0.9	27.3	87.4	3 512
Muskingum	77 826	0.5	2.8	86.5	10.9	6.5	90.2	12.0	1.3	27.8	83.9	3 131
Noble	10 428	0.7	2.4	90.3	12.7	0.9	90.7	11.4	1.0	23.7	86.6	3 912
Ottawa	37 099	1.7	11.1	80.9	15.8	6.1	88.7	12.0	0.6	25.0	89.0	3 309
Paulding	19 329	0.2	2.3	78.3	15.4	2.8	94.4	12.0	1.3	30.4	87.4	3 662
Perry	27 434	0.6	3.0	87.2	11.8	10.7	92.1	11.2	1.8	27.1	88.2	3 580
Pickaway	40 071	0.4	1.7	76.2	21.1	2.2	89.5	12.1	1.1	29.8	83.2	2 767
Pike	19 114	0.4	1.3	74.2	16.0	0.2	90.5	9.9	1.1	27.5	82.5	3 571
Portage	125 856	2.1	8.3	66.1	24.7	8.4	96.3	12.2	1.5	29.8	89.7	3 279
Preble	34 719	0.3	2.0	69.4	15.4	0.4	98.3	11.9	1.0	27.0	90.6	3 226
Putnam	31 134	0.9	4.2	89.4	10.1	21.3	96.3	12.1	1.1	34.2	92.3	4 251
Richland	129 997	2.4	6.5	73.8	13.0	7.6	95.3	12.0	0.8	27.4	86.4	2 999
Ross	61 211	0.7	2.2	81.1	11.8	3.6	92.4	11.3	1.6	27.6	84.9	3 014
Sandusky	60 983	1.4	7.4	82.2	13.7	18.7	95.1	12.1	1.1	27.7	88.1	3 379
Scioto	76 951	0.3	1.5	74.7	10.5	4.6	89.1	10.4	1.5	22.9	82.9	3 097
Seneca	60 696	1.0	4.5	84.1	13.3	18.2	93.3	12.1	1.2	28.2	88.0	3 564
Shelby	37 748	0.4	2.0	81.7	14.0	4.4	94.6	12.0	1.1	30.9	89.3	3 663
Stark	372 210	2.7	9.8	77.3	11.1	15.8	94.8	12.1	1.0	26.5	87.5	3 019
Summit	553 371	3.9	11.2	67.7	11.4	13.1	96.1	12.2	1.1	25.7	85.1	2 960
Trumbull	232 579	3.7	15.0	67.3	11.2	13.7	96.9	12.1	1.4	26.4	88.1	3 005
Tuscarawas	77 211	1.1	6.3	86.7	9.5	6.1	92.3	12.0	1.0	24.4	87.2	2 957
Union	23 786	0.3	2.0	83.7	17.7	5.9	93.5	12.1	1.2	24.2	88.0	3 155
Van Wert	29 194	0.8	2.9	81.8	13.4	12.9	96.5	12.2	0.9	25.0	88.5	3 336
Vinton	9 420	0.2	1.3	83.3	13.8	-	82.5	10.1	1.7	25.9	87.4	3 371
Warren	84 925	0.5	2.2	65.1	22.0	3.5	91.4	11.4	1.5	30.6	89.4	3 083
Washington	57 160	0.4	2.3	65.9	15.7	4.0	94.8	12.1	1.0	28.0	88.0	2 984
Wayne	87 123	1.0	4.7	77.8	15.9	8.4	89.3	12.1	1.2	28.2	86.6	3 217
Williams	33 669	0.5	3.5	73.9	15.2	5.3	94.2	12.2	0.7	28.7	90.4	3 303
Wood	89 722	1.6	7.1	79.7	27.2	10.1	97.6	12.2	0.6	25.8	91.3	3 148
Wyandot	21 826	0.7	3.4	84.8	12.8	18.1	98.5	12.1	0.6	28.2	88.8	3 381

[1] Children ever born per 1,000 women of all marital classes.

Table 43. Summary of Social Characteristics by Counties: 1970

[Data based on sample, see text. For minimum base for derived figures (percent, median, etc.) and meaning of symbols, see text]

Counties	Total population			Native population - Percent residing in State of birth	Persons 5 years and over - Percent migrant	Children in elementary school - Percent in private school	Persons 14 to 17 years - Percent in school	Persons 25 years and over - Median school years completed	Married couples - Percent without own household	Families - Percent with own children under 6 years	Persons under 18 years - Percent living with both parents	Women 35 to 44 years - Cumulative fertility rate[1]
	Number	Percent foreign born	Percent native of foreign or mixed parentage									
The State	1 744 236	1.0	3.3	81.4	12.7	3.3	88.3	10.6	1.7	23.7	82.3	3 030
Barbour	14 030	0.8	1.7	87.5	16.3	0.3	89.5	8.9	2.7	19.8	82.3	3 306
Berkeley	36 356	0.7	2.2	75.4	11.9	3.6	86.3	10.6	1.0	27.9	84.2	2 728
Boone	25 118	0.4	1.0	88.0	12.5	0.4	85.3	8.7	2.4	25.0	82.5	3 548
Braxton	12 666	0.1	0.7	92.3	12.3	-	94.1	8.7	3.0	22.0	77.6	3 734
Brooke	29 685	3.3	13.4	68.5	12.1	11.7	93.9	11.1	1.4	25.1	87.0	2 944
Cabell	106 918	0.8	2.1	76.2	15.5	3.0	87.9	11.9	1.5	22.9	79.7	2 668
Calhoun	7 046	-	0.3	92.5	9.8		93.2	8.6	1.9	20.5	75.0	3 504
Clay	9 330	-	0.2	91.0	11.0	-	86.5	8.4	2.2	26.7	78.2	3 709
Doddridge	6 389	-	1.0	90.6	13.6	-	78.7	8.8	5.3	19.3	80.2	3 332
Fayette	49 332	1.0	3.1	84.6	13.1	0.5	89.0	9.0	1.9	20.3	76.2	3 602
Gilmer	7 782	0.4	0.7	90.1	23.6	-	90.0	8.9	1.4	23.0	79.8	2 848
Grant	8 607	0.1	0.3	88.5	11.3	0.6	89.2	8.9	1.9	25.5	86.8	3 273
Greenbrier	32 090	0.5	0.9	84.3	9.9	0.8	88.2	9.8	1.8	22.6	84.4	3 198
Hampshire	11 710	0.2	0.9	80.3	12.3	7.0	89.0	8.9	2.2	24.7	77.0	2 980
Hancock	39 749	4.0	14.7	62.7	9.4	11.3	96.2	11.3	1.4	24.7	89.1	2 858
Hardy	8 855	0.1	0.9	88.3	5.6		83.9	8.7	2.0	25.3	80.4	2 830
Harrison	73 028	1.7	6.0	84.9	11.2	6.5	86.6	12.0	1.5	22.2	82.8	2 732
Jackson	20 903	0.3	1.2	87.4	14.6	-	91.2	11.0	0.5	25.2	85.3	3 082
Jefferson	21 280	0.6	1.9	70.1	18.0	0.5	79.9	10.7	1.9	26.8	79.6	2 732
Kanawha	229 515	0.6	2.3	82.9	10.4	3.3	90.3	12.1	1.1	22.1	82.0	2 804
Lewis	17 847	0.7	1.3	91.1	12.6	4.8	87.3	8.9	1.8	21.6	80.6	2 586
Lincoln	18 912	0.2	0.3	93.5	10.7	0.7	86.8	8.5	2.0	27.1	81.9	3 673
Logan	46 269	0.7	1.5	85.0	7.9	0.4	87.8	8.9	2.3	25.3	79.1	3 570
McDowell	50 666	1.1	2.3	76.9	7.4	0.3	87.4	8.7	2.0	23.8	75.8	3 925
Marion	61 356	2.0	6.8	85.1	10.4	3.5	87.8	11.7	1.3	20.8	82.2	2 597
Marshall	37 598	1.7	7.5	83.5	11.6	13.6	90.0	10.7	1.6	24.0	87.3	2 811
Mason	24 306	0.3	0.8	82.6	12.9	-	85.8	9.7	1.6	26.2	85.8	2 957
Mercer	63 206	0.5	2.1	73.4	13.8	0.5	88.2	11.0	2.8	22.6	80.2	3 021
Mineral	23 109	0.7	2.7	72.8	17.3	4.6	86.0	11.2	1.5	26.2	83.3	3 068
Mingo	32 780	0.3	0.9	75.8	11.0	0.5	84.3	8.5	1.6	24.1	78.8	3 755
Monongalia	63 714	2.3	6.5	71.7	28.2	1.7	85.0	12.1	1.6	25.2	85.3	2 764
Monroe	11 272	0.5	0.9	81.2	17.1	-	92.3	9.9	2.1	22.8	84.7	2 826
Morgan	8 547	0.4	1.0	77.0	15.0	0.8	90.1	9.0	1.3	24.4	83.9	2 957
Nicholas	22 552	0.4	1.1	92.1	11.4	0.4	89.2	8.8	2.2	25.7	82.9	3 384
Ohio	64 197	2.6	12.3	72.9	12.3	25.5	96.5	11.6	1.4	20.6	85.2	2 640
Pendleton	7 031	0.3	0.5	83.1	5.3	-	83.2	8.7	3.7	18.7	81.6	2 610
Pleasants	7 274	0.1	0.9	80.2	16.7	0.5	69.4	11.4	1.3	27.6	74.6	2 879
Pocahontas	8 870	0.3	1.1	87.2	11.0		92.6	8.9	3.0	20.0	76.4	3 139
Preston	25 455	0.7	2.3	85.5	7.8	0.1	93.0	9.1	2.2	25.2	83.6	3 172
Putnam	27 625	0.4	1.0	89.4	20.3	-	87.5	10.5	0.8	25.8	87.0	3 098
Raleigh	70 080	0.8	2.4	82.8	11.4	1.7	83.1	9.8	2.6	22.3	79.5	3 199
Randolph	24 596	0.3	2.2	85.8	14.2	3.1	80.5	10.0	2.8	24.0	81.7	3 195
Ritchie	10 145	0.1	0.9	91.9	10.9	0.5	90.4	9.0	2.1	23.0	84.4	3 436
Roane	14 111	0.2	0.5	93.4	13.2	0.2	87.1	8.7	1.2	20.3	83.5	3 355
Summers	13 213	0.1	0.5	90.7	9.8	-	90.6	8.9	2.7	19.6	77.6	3 291
Taylor	13 878	0.6	2.5	89.3	15.1	3.9	90.2	10.2	2.8	22.8	78.3	3 071
Tucker	7 447	1.0	4.9	86.7	15.5	-	89.4	9.6	0.9	24.4	82.3	3 362
Tyler	9 929	0.5	2.1	84.9	16.3	0.4	86.8	11.0	0.8	29.3	84.2	3 117
Upshur	19 092	0.5	1.9	81.8	20.1	0.4	90.0	10.0	1.2	24.4	85.8	3 015
Wayne	37 581	0.3	0.7	80.6	12.9	1.3	83.8	10.0	2.0	26.1	83.6	3 031
Webster	9 809	0.3	1.0	92.1	8.3	0.4	72.7	8.5	3.6	25.7	76.7	3 634
Wetzel	20 314	0.5	2.1	85.1	12.9	2.4	88.5	11.5	1.3	28.1	85.8	3 184
Wirt	4 154	0.1	1.0	91.0	16.9	-	82.9	9.0	1.6	26.6	81.5	3 170
Wood	86 818	0.6	1.7	82.0	12.7	3.0	91.7	12.0	1.1	27.2	86.0	2 973
Wyoming	30 094	0.3	0.9	83.0	12.1	0.4	86.7	8.9	2.0	28.0	84.9	3 370

[1] Children ever born per 1,000 women of all marital classes.

Table 44. Summary of Economic Characteristics by Counties: 1970

[Data based on sample, see text. For minimum base for derived figures (percent, median, etc.) and meaning of symbols, see text]

Counties	Nonworker-worker ratio	Percent in labor force					Civilian labor force--Percent unemployed	Employed persons			Worked during census week--Percent working outside county of residence	Persons who worked in 1969--Percent worked 50 to 52 weeks	Families		
		Female, 16 years and over	Married women, husband present		Male			Percent in manufacturing industries	Percent in white-collar occupations	Percent government workers			Median income (dollars)	Percent with income of	
			Total	With own children under 6 years	18 to 24 years	65 years and over								Less than poverty level	$15,000 or more
The State	1.48	40.1	36.7	24.7	75.1	24.1	4.0	35.6	45.4	13.1	15.6	59.0	10 313	7.6	21.6
Adams	2.12	26.4	26.8	22.2	75.1	24.4	5.4	18.2	29.7	17.4	18.8	55.9	5 563	27.4	5.9
Allen	1.48	42.1	39.3	26.7	79.0	27.5	4.2	33.8	43.4	9.7	11.6	59.1	10 091	6.7	19.9
Ashland	1.37	42.1	42.0	31.3	68.4	29.4	2.6	41.8	38.6	11.6	18.1	56.7	9 507	6.6	[illegible]
Ashtabula	1.54	38.2	36.1	29.2	80.3	22.4	4.0	39.3	36.6	10.4	12.5	56.9	9 894	7.5	17.1
Athens	1.79	35.0	38.4	23.4	40.5	19.9	5.9	13.2	49.0	39.7	15.2	35.1	7 620	13.1	11.4
Auglaize	1.46	41.1	38.8	25.1	87.0	25.0	2.7	43.1	35.0	9.2	26.0	67.5	9 628	5.3	13.7
Belmont	1.72	30.4	26.5	17.2	74.0	20.4	4.4	28.2	34.9	8.9	40.0	58.4	8 455	9.9	9.9
Brown	1.85	32.3	31.0	22.5	78.8	24.5	4.6	34.1	32.2	14.8	44.2	57.8	7 674	14.8	8.7
Butler	1.57	37.2	35.2	22.9	65.0	21.6	3.7	41.3	43.8	13.0	22.5	53.8	10 388	7.0	21.1
Carroll	1.65	33.8	32.9	24.6	83.4	25.4	4.1	45.5	26.9	9.3	50.6	64.4	8 635	11.3	9.4
Champaign	1.39	41.7	40.3	33.1	82.2	31.8	4.2	42.5	32.0	9.9	30.6	65.4	9 354	6.8	14.6
Clark	1.52	38.3	36.5	26.2	73.4	26.3	3.9	35.7	43.9	16.3	23.5	59.2	9 996	7.3	19.1
Clermont	1.62	39.3	38.4	27.1	81.8	26.8	3.9	39.6	38.8	10.2	68.8	56.9	10 204	7.0	18.7
Clinton	1.50	39.3	37.2	29.3	80.6	31.3	3.9	28.4	38.1	19.4	21.6	59.2	8 804	10.4	14.3
Columbiana	1.57	35.1	33.4	20.4	81.9	24.9	5.1	44.9	33.7	9.0	28.8	59.6	9 032	7.8	12.7
Coshocton	1.53	37.4	35.8	22.8	84.5	26.5	5.2	42.0	33.4	10.8	11.4	57.4	8 343	11.0	11.3
Crawford	1.41	42.2	39.8	30.5	86.5	23.9	4.4	48.6	36.5	9.8	14.8	66.6	9 500	7.0	14.1
Cuyahoga	1.35	42.6	37.3	23.6	75.4	26.0	3.7	33.8	51.1	13.0	3.8	59.7	11 309	7.4	28.2
Darke	1.48	40.1	38.3	28.3	89.7	26.5	3.9	38.2	32.9	7.7	35.0	64.4	9 130	8.4	14.5
Defiance	1.52	40.9	39.1	26.7	77.6	26.0	4.7	42.6	33.7	10.7	18.0	60.5	9 945	7.5	18.1
Delaware	1.40	41.7	42.6	29.8	67.6	29.9	2.9	28.1	44.6	14.0	39.4	58.9	9 883	6.1	18.7
Erie	1.48	41.4	38.9	26.3	82.7	23.0	4.4	39.7	40.0	10.4	13.8	65.0	10 688	6.0	21.8
Fairfield	1.56	38.6	36.3	25.8	80.9	24.6	3.9	40.5	39.1	13.0	25.6	64.9	8 967	8.4	13.5
Fayette	1.52	36.9	36.1	22.7	87.6	27.2	5.2	29.2	35.8	14.3	22.1	64.0	7 891	12.5	11.3
Franklin	1.33	46.3	43.4	30.1	68.7	28.9	3.4	22.9	56.9	19.9	2.6	57.0	10 582	7.6	23.7
Fulton	1.47	41.2	40.3	32.1	91.0	29.2	4.3	37.6	34.2	10.3	24.9	62.9	10 155	5.0	18.5
Gallia	2.10	30.7	33.5	22.2	54.2	16.6	6.0	15.0	37.3	21.8	16.0	55.2	6 915	19.1	9.1
Geauga	1.54	38.4	32.9	19.1	80.7	26.3	2.2	39.0	46.0	9.2	54.5	60.8	12 411	4.8	34.5
Greene	1.39	40.3	37.7	23.0	77.5	29.0	3.5	28.4	50.6	26.6	44.9	59.3	11 694	5.2	29.2
Guernsey	1.71	37.7	38.9	33.4	81.1	19.4	4.7	34.7	32.6	17.1	10.6	60.2	7 990	12.2	10.3
Hamilton	1.49	41.1	36.6	25.2	73.7	25.8	3.8	32.1	53.2	12.9	5.6	58.7	10 486	8.3	24.1
Hancock	1.41	42.6	40.6	29.6	82.3	27.0	3.2	32.4	45.2	9.8	15.6	60.9	10 363	6.0	20.6
Hardin	1.65	34.7	35.4	25.6	56.1	25.5	2.9	34.7	34.0	10.2	23.1	55.2	8 369	12.0	11.1
Harrison	1.79	30.2	27.8	11.8	82.2	22.3	3.3	20.4	27.0	12.3	27.4	63.2	8 127	14.8	7.6
Henry	1.54	40.1	40.5	31.5	84.6	26.1	4.0	38.1	32.5	9.8	24.7	60.7	9 994	6.5	16.0
Highland	1.69	34.3	33.3	24.4	81.8	30.6	4.3	30.5	33.1	14.9	20.1	62.9	7 194	15.3	8.2
Hocking	1.80	33.1	31.5	24.5	82.6	19.0	7.1	37.3	34.3	14.6	29.5	57.9	7 742	14.2	9.4
Holmes	1.88	30.0	25.5	13.8	87.9	29.5	2.3	34.0	22.3	8.6	23.3	70.6	7 584	16.8	11.3
Huron	1.54	40.7	38.8	26.4	86.3	28.1	3.5	38.5	33.7	10.9	19.9	66.4	9 838	7.1	17.6
Jackson	2.04	30.5	32.0	23.2	68.7	15.9	7.6	30.8	34.7	17.5	16.2	58.5	6 635	20.5	7.4
Jefferson	1.80	28.7	24.3	13.2	70.0	17.8	4.1	37.3	36.8	10.5	24.5	58.0	9 347	8.5	13.8
Knox	1.49	37.9	36.5	24.9	63.8	28.0	3.1	35.4	40.4	11.2	13.2	63.0	8 788	8.1	13.1
Lake	1.43	41.2	38.3	21.5	78.6	23.3	2.8	46.9	45.9	9.1	46.2	60.9	11 964	3.6	28.0
Lawrence	2.01	28.2	25.5	16.6	77.9	16.5	6.3	35.8	36.3	12.6	41.5	64.1	7 712	16.3	7.5
Licking	1.55	37.4	34.8	25.3	75.8	25.2	5.1	32.8	42.0	17.1	16.2	60.0	9 305	8.4	14.6
Logan	1.52	37.5	37.2	30.5	84.4	27.2	3.5	32.9	34.5	11.0	22.4	63.4	8 399	9.6	12.2
Lorain	1.55	38.1	34.3	21.3	77.7	22.8	3.7	42.8	39.3	10.4	18.0	58.2	10 801	5.7	21.7
Lucas	1.43	41.5	37.7	25.7	82.5	22.5	4.1	32.9	47.3	12.2	7.6	57.3	10 823	7.0	24.3
Madison	1.56	41.8	40.1	34.1	72.7	36.2	4.9	26.6	34.0	16.6	42.1	59.4	8 970	8.9	14.6
Mahoning	1.55	35.4	30.1	18.0	78.4	20.0	5.8	37.9	42.7	10.6	18.0	57.4	10 096	7.4	19.6
Marion	1.54	38.1	35.5	24.5	83.2	26.4	3.7	38.4	39.9	10.3	5.2	65.7	9 153	6.6	11.8
Medina	1.53	38.9	36.2	22.2	84.1	25.7	3.1	38.8	41.3	10.3	54.6	61.3	11 178	4.5	23.9
Meigs	2.17	24.3	23.5	12.5	70.1	14.7	7.5	18.2	34.9	17.3	37.9	57.2	6 485	22.1	4.2
Mercer	1.54	41.7	38.5	27.8	87.2	31.0	2.4	35.7	32.5	7.6	17.5	62.6	9 574	6.3	14.9
Miami	1.42	40.3	38.7	26.3	86.7	27.6	3.1	45.0	40.2	10.0	27.3	67.0	10 233	6.2	19.7
Monroe	2.20	22.6	19.8	11.6	76.9	20.4	5.8	36.5	30.7	14.9	17.5	56.6	7 630	17.5	8.8
Montgomery	1.36	43.4	39.1	25.4	78.5	22.4	4.0	38.0	49.4	14.7	7.6	58.9	11 413	6.1	28.1
Morgan	2.02	27.0	26.7	17.8	78.9	14.1	7.9	28.7	32.0	17.2	25.9	62.0	7 171	16.4	8.1
Morrow	1.58	37.1	35.6	25.2	86.6	27.1	3.6	44.6	29.9	10.9	44.8	63.9	8 599	9.4	11.7
Muskingum	1.63	37.8	35.3	29.1	77.1	22.3	4.9	33.3	38.2	9.9	10.3	61.8	8 313	10.9	10.2
Noble	1.87	30.5	28.9	20.0	79.3	26.2	6.9	22.5	28.6	17.4	27.1	54.5	7 120	19.9	7.6
Ottawa	1.63	34.7	32.7	20.6	85.8	23.5	4.8	38.1	39.4	11.1	34.2	59.5	9 760	7.0	17.0
Paulding	1.74	36.5	36.5	25.3	79.2	16.0	5.5	46.9	30.1	10.1	45.7	60.8	9 222	10.0	12.2
Perry	2.01	29.1	27.8	23.1	75.1	23.0	6.4	42.7	27.7	13.2	39.5	58.5	7 318	14.9	6.2
Pickaway	1.78	35.0	36.7	21.8	69.9	23.6	4.1	30.0	38.8	15.2	36.0	65.8	8 705	10.8	13.4
Pike	2.41	24.6	25.3	21.3	72.5	14.7	12.2	28.9	36.8	21.0	30.7	52.4	6 559	24.2	8.5
Portage	1.47	40.6	38.8	24.4	63.0	25.6	6.0	37.6	41.9	20.4	41.2	47.6	10 992	5.2	23.6
Preble	1.52	38.1	36.5	24.3	84.3	26.7	3.4	38.4	34.1	11.8	50.3	59.7	9 612	6.3	15.8
Putnam	1.84	36.4	33.4	24.8	81.9	17.5	3.7	41.6	29.0	10.1	34.8	62.0	9 188	7.6	14.6
Richland	1.42	43.2	40.8	28.5	67.2	26.6	3.9	43.7	39.9	10.2	6.2	60.2	10 117	7.1	18.4
Ross	1.84	34.7	31.9	24.8	76.1	16.7	5.2	32.9	37.4	18.7	13.2	63.8	8 617	13.0	11.8
Sandusky	1.59	38.5	36.8	27.2	85.9	20.3	3.9	41.5	35.7	10.3	20.9	64.2	9 807	6.9	17.8
Scioto	2.04	28.8	26.3	17.5	77.9	14.5	7.6	29.6	39.6	14.4	11.3	61.2	7 546	16.2	8.9
Seneca	1.56	40.0	38.3	30.6	78.0	23.9	3.9	42.0	33.4	9.4	16.9	61.9	9 431	6.8	14.0
Shelby	1.43	43.8	41.3	28.4	89.8	26.7	3.3	47.4	35.1	9.5	13.5	68.2	9 439	7.9	15.0
Stark	1.49	38.3	34.9	22.2	81.7	21.6	4.3	42.0	42.6	9.2	11.3	59.9	10 249	5.8	19.0
Summit	1.47	39.1	35.1	21.9	78.6	19.5	4.0	39.7	48.4	10.5	16.5	58.9	11 058	6.3	24.7
Trumbull	1.47	39.3	35.6	27.0	81.8	21.9	5.2	49.1	36.3	9.2	20.2	58.8	10 778	5.4	22.6
Tuscarawas	1.63	34.5	31.0	19.9	87.4	16.4	4.8	41.6	36.7	10.5	14.8	65.0	8 544	8.5	9.7
Union	1.46	40.3	42.1	31.5	85.6	29.4	3.8	34.7	38.0	13.6	25.7	63.5	9 165	6.9	17.3
Van Wert	1.46	39.8	39.0	32.7	84.9	24.7	4.4	41.1	36.4	9.3	27.5	62.6	9 156	8.4	12.1
Vinton	2.17	27.0	26.8	16.8	74.8	17.6	8.3	29.7	28.7	25.0	31.9	53.8	6 334	19.9	7.2
Warren	1.61	39.1	37.6	26.1	68.3	22.0	3.7	46.8	34.4	10.6	63.9	57.7	10 679	6.0	20.6
Washington	1.75	32.6	29.5	17.9	64.9	21.5	4.8	29.6	42.7	12.9	21.5	59.0	8 568	11.0	12.1
Wayne	1.38	43.1	40.4	27.7	78.0	33.3	3.1	37.4	36.9	11.9	15.9	59.0	9 992	6.4	18.2
Williams	1.43	42.7	43.3	34.8	86.6	23.8	4.5	44.1	36.2	9.9	14.2	62.9	9 494	7.4	14.3
Wood	1.45	40.3	37.2	24.3	57.7	28.3	3.4	28.4	44.9	20.6	40.4	45.6	10 878	5.3	24.3
Wyandot	1.55	39.9	39.8	34.2	90.5	23.4	3.6	37.0	27.7	10.4	27.1	64.3	8 679	8.0	11.3

Table 44. Summary of Economic Characteristics by Counties: 1970

[Data based on sample, see text. For minimum base for derived figures (percent, median, etc.) and meaning of symbols, see text]

Counties	Nonworker-worker ratio	Percent in labor force					Civilian labor force—Percent unemployed	Employed persons			Worked during census week—Percent working outside county of residence	Persons who worked in 1969—Percent worked 50 to 52 weeks	Families		
		Female, 16 years and over	Married women, husband present		Male			Percent in manufacturing industries	Percent in white-collar occupations	Percent government workers			Median income (dollars)	Percent with income of—	
			Total	With own children under 6 years	18 to 24 years	65 years and over								Less than poverty level	$15,000 or more
The State	1.98	29.4	27.5	17.9	64.0	16.7	5.1	23.3	40.4	16.5	17.3	50.2	7 415	18.0	9.6
Barbour	2.13	28.1	25.6	21.2	54.1	15.6	7.0	11.7	31.8	12.7	28.4	49.9	5 324	25.9	4.8
Berkeley	1.55	40.1	39.1	30.7	83.5	18.1	4.0	32.3	36.7	16.1	15.5	62.2	8 001	11.9	10.5
Boone	2.72	19.9	19.8	13.4	67.9	13.1	7.8	7.4	30.7	16.1	23.6	39.8	6 180	36.1	5.7
Braxton	2.99	19.4	19.0	14.8	64.4	7.8	10.6	14.6	37.7	24.9	13.3	47.8	4 902	37.1	3.9
Brooke	1.67	30.9	26.9	14.6	75.8	17.3	3.4	46.0	34.5	10.1	44.0	61.0	9 296	8.6	12.9
Cabell	1.66	33.9	32.4	22.5	66.0	17.6	4.9	26.0	49.3	15.1	10.5	58.4	8 109	13.1	13.6
Calhoun	2.75	22.5	23.9	22.8	60.7	7.4	10.1	28.8	34.7	34.9	24.7	50.3	4 504	37.1	5.9
Clay	3.73	14.0	10.8	3.3	63.3	5.7	15.4	20.3	27.1	21.0	42.8	49.2	4 179	39.6	2.7
Doddridge	2.34	24.2	23.3	27.5	61.8	14.0	6.9	22.1	23.6	17.6	33.2	59.7	5 896	23.4	4.5
Fayette	2.91	20.3	19.4	11.8	48.4	11.5	5.8	15.2	38.0	18.9	20.8	52.6	6 034	23.6	6.1
Gilmer	2.29	28.8	27.0	19.0	48.9	11.6	7.3	15.6	38.2	42.7	20.5	35.1	4 485	36.8	4.1
Grant	1.91	29.4	27.8	24.2	68.4	28.7	5.7	29.3	26.9	12.5	22.4	50.9	5 320	28.0	5.8
Greenbrier	2.00	28.2	27.3	19.9	67.0	25.5	6.2	13.6	36.9	16.3	13.2	54.0	6 016	21.1	6.5
Hampshire	1.72	34.7	32.4	22.8	76.9	24.0	7.1	24.2	30.3	20.2	24.1	47.7	6 119	20.6	5.0
Hancock	1.70	30.8	25.1	14.7	76.0	18.4	2.7	55.0	33.0	8.4	26.1	62.7	10 380	5.9	17.9
Hardy	1.76	29.6	32.0	26.3	76.0	21.9	6.3	30.5	23.3	15.4	26.6	53.8	5 300	26.9	6.7
Harrison	1.80	30.1	27.1	17.8	66.3	17.4	4.8	22.4	42.5	11.1	7.5	64.6	7 717	13.2	8.8
Jackson	2.06	25.6	25.9	13.5	69.5	22.4	7.9	38.4	37.4	16.6	20.7	60.0	7 959	17.0	8.0
Jefferson	1.50	37.8	35.4	22.4	74.7	25.9	3.0	20.1	39.3	20.2	27.9	59.4	7 721	13.4	11.4
Kanawha	1.65	34.3	32.1	19.4	69.6	22.2	4.1	19.1	52.0	16.0	4.6	64.3	8 649	13.0	15.3
Lewis	2.22	29.4	32.3	22.6	69.0	12.6	5.0	22.1	32.8	24.8	10.2	60.8	5 919	22.4	5.2
Lincoln	3.13	19.8	18.4	16.3	59.5	10.1	9.3	22.6	28.6	16.9	43.5	49.1	5 058	38.0	4.4
Logan	2.77	23.1	21.7	13.4	62.4	14.2	4.7	7.1	40.3	15.4	5.8	60.7	7 077	23.0	7.9
McDowell	3.20	19.1	18.6	9.0	58.0	11.3	7.4	4.2	32.9	16.3	9.3	58.5	5 868	29.3	4.6
Marion	1.77	31.8	29.5	19.8	61.5	13.0	3.7	26.6	34.5	13.1	8.0	59.3	7 807	12.6	8.7
Marshall	1.69	33.0	30.5	17.8	70.1	18.9	4.8	36.8	30.7	10.2	28.0	57.1	8 492	10.5	10.7
Mason	2.18	24.1	21.7	14.5	74.1	13.0	6.6	28.1	31.0	16.0	29.2	53.5	6 768	23.1	4.9
Mercer	1.95	30.4	28.5	20.8	65.5	13.7	5.0	14.4	43.4	18.3	16.9	57.1	6 945	18.0	8.5
Mineral	1.93	28.5	25.3	15.3	52.7	20.7	5.6	32.8	32.9	14.9	50.7	60.9	7 548	16.2	6.2
Mingo	3.42	19.3	18.8	12.8	61.3	12.7	5.3	6.7	38.5	17.8	21.9	52.5	5 127	36.5	4.5
Monongalia	1.75	34.5	33.5	20.1	39.1	19.7	4.2	11.9	49.3	37.5	9.1	46.5	7 758	13.1	12.1
Monroe	2.25	23.9	31.0	24.6	63.2	18.3	9.1	30.6	27.2	21.8	44.6	56.6	5 516	29.2	4.9
Morgan	1.84	31.2	32.4	20.8	71.9	18.7	6.1	26.8	29.1	16.4	37.9	55.8	6 897	15.0	6.5
Nicholas	2.42	24.3	22.6	16.2	64.7	11.8	8.0	12.9	30.4	14.1	11.4	58.2	6 623	25.2	5.3
Ohio	1.52	36.7	30.3	17.4	63.2	23.7	3.7	21.0	47.6	12.2	17.8	55.3	8 770	10.3	14.3
Pendleton	2.17	25.3	24.9	22.4	69.7	23.8	5.2	27.2	27.5	24.1	12.1	52.2	5 358	28.7	5.7
Pleasants	2.12	30.1	29.7	18.1	54.9	19.9	5.4	33.1	38.9	27.2	28.3	65.3	8 235	14.9	12.1
Pocahontas	2.45	21.1	19.7	8.8	63.4	11.5	8.9	23.8	31.1	34.7	10.2	50.5	5 089	27.2	5.0
Preston	2.19	27.2	27.2	18.5	71.0	11.7	4.8	23.7	27.7	19.8	27.6	56.4	5 626	26.8	4.8
Putnam	2.04	23.4	21.7	12.4	73.9	12.1	3.8	31.8	33.5	14.6	56.2	61.6	8 156	13.7	8.1
Raleigh	2.41	25.2	23.4	14.0	66.3	12.2	5.8	7.3	40.3	15.5	11.3	57.9	6 737	19.6	7.2
Randolph	2.00	30.6	30.5	23.1	56.8	19.6	5.6	18.4	40.9	17.1	7.2	56.0	5 870	24.0	5.8
Ritchie	2.17	27.3	27.8	17.5	67.2	14.0	13.4	36.3	24.9	12.9	30.1	53.1	5 681	25.0	2.7
Roane	2.58	24.4	27.1	23.4	60.5	13.0	8.6	24.9	37.2	22.7	16.1	52.2	5 517	27.1	4.3
Summers	2.76	20.3	18.8	10.0	66.4	17.9	11.7	8.1	37.1	19.6	15.1	51.1	5 130	33.7	4.3
Taylor	2.00	30.5	29.2	27.5	77.3	9.0	6.1	21.6	34.7	17.3	26.5	56.7	6 644	18.9	5.1
Tucker	2.05	28.7	31.1	22.9	57.7	17.8	4.2	31.0	33.9	28.2	12.7	58.3	5 243	24.9	5.4
Tyler	2.25	23.3	22.2	7.6	83.4	20.0	2.7	44.4	29.9	15.2	38.3	66.5	7 362	18.5	6.8
Upshur	2.06	29.1	29.1	21.2	49.7	15.8	5.8	21.4	40.5	16.3	13.1	50.1	6 228	21.8	6.3
Wayne	2.13	27.2	24.8	14.9	72.1	13.1	5.5	31.1	37.1	15.0	58.3	56.7	7 033	21.1	7.4
Webster	3.09	18.8	17.6	11.9	58.6	8.3	9.3	18.2	29.0	23.6	18.8	49.4	4 208	39.1	3.6
Wetzel	2.15	23.6	21.3	7.9	84.4	14.1	6.4	43.5	32.4	11.5	41.7	61.9	8 185	16.9	11.6
Wirt	2.22	24.1	23.3	16.9	80.1	18.2	6.6	41.4	31.3	19.7	48.9	46.0	5 688	28.9	6.8
Wood	1.61	36.0	33.4	22.7	79.1	21.9	4.4	37.0	43.6	13.6	11.9	64.2	8 766	9.7	13.3
Wyoming	2.83	16.0	15.7	6.5	69.4	11.0	4.1	7.3	28.0	14.6	10.1	59.6	7 284	21.9	5.2

A SUMMARY OF THE BUFFALO AIR POLLUTION STUDY

The Erie County Air Pollution-Respiratory Function Study was set up in 1961 to examine the association between respiratory disease mortality and air pollution independent of socioeconomic status. Buffalo and Erie County seemed to be a good place to examine such an association since the major contributors to air pollution are large industries located to the windward of the city producing two wide bands of heavy pollution traversing areas of varied socioeconomic status.

The pollutants measured were: suspended particulates, settleable solids, and oxides of sulfur. Mortality data for three years was collected according to census tract of residence.

Five levels of socioeconomic status were used. The levels were based on median family income for census tract of residence. Other socioeconomic variables examined were: median years of school completed, percent laborers in labor force, and percent of sound housing.

The study focused on white men 50 years of age and over. A positive relationship between air pollution level and total mortality was found in both the 50-69 year age group and the 70 year and over group. The relationship was stronger in the 50-69 year age group. It was also stronger in the three lower economic groups.

The importance of occupational exposure was reduced as a factor when the data on women in the same age groups showed similar relationships.

Additional factors that may have contributed to the results but for which data was not collected were: tobacco use and residential mobility.

A report of the entire study can be found in the Archives of Environmental Health, Volume 14, January, 1967, pages 162-171. The complete title and authors are: "The Relationship of Air Pollution and Economic Status to Total Mortality and Selected Respiratory System Mortality in Men", by W. Winkelstein, S. Kantor, E. Davis, C. Maneri, and W. Mosher.

A SUMMARY OF THE NASHVILLE AIR POLLUTION STUDY

The Nashville Air Pollution Study began in 1957 sponsored by the Division of Air Pollution of the U. S. Public Health Service. One portion of this study examined the effects of air pollution on mortality.

The objectives of the study were: 1) to determine mortality for total and specified respiratory diseases in the Nashville area; 2) to study the relationship between mortality for respiratory diseases and demographic, social and economic characteristics of the population; and 3) to determine whether mortality for respiratory diseases varies significantly with exposure in the residential environment to different levels of air pollution.

Data cards on all deaths during an 11 year period were examined. Age, sex, race, marital status and cause of death were noted. Residence at time of death was coded by census tract.

Each census tract was classified socioeconomically as upper, middle, or lower class based on: 1) mean occupational level; 2) median family income; 3) median number of school years completed for persons 25 years or older; and 4) percentage of households with more than 1.01 persons per room.

All census tracts were also classified as being in the high, moderate, or low atmospheric pollution category based on four indices: 1) sulfation (mg/100 sq cm/day); 2) dustfall (tons/sq mile/month); 3) soiling index (concentration of haze and smoke per 1000 linear feet); and 4) 24-hour sulfur dioxide in parts per million.

As expected, the influence of socioeconomic factors on mortality was observed. The relationship was especially marked for tuberculosis and somewhat for influenza and pneumonia. Death rates for respiratory diseases in highly polluted areas were significantly higher than those in moderately polluted areas with the exception of bronchitis, emphysema, lung and bronchial cancer.

For all respiratory diseases, the rates were **always higher** among males than females. With the exception of lung and bronchial cancer, death rates for other respiratory diseases were higher in the nonwhite population than in the white. There was generally a direct relationship between mortality and pollution level from ages 25 to 75 years.

The following assumptions were made in planning and developing the study: 1) residence at time of death was characteristic of residentail environment during much of the person's lifetime; 2) measured pollution level in 1958-59 was representative of the level during the individual's life.

Additional limitations discussed are: 1) smoking factor was not controlled; 2) the reluctance of American physicians to ascribe deaths to bronchitis and emphysema; (There is a marked difference between mortality due to these two illnesses in Britian and the U.S.) and 3) other factors such as stress, diet, and occupation which may be of critical importance.

Source: "The Nashville Air Pollution Study. Parts V, VI, and VII." by L. D. Zeidberg, R. Horton, and E. Landau, Arch. Environ. Health, Vol. 15, August, 1967, pp. 214-248.

APPENDIX F

Evaluation of Air Quality Activities,
1974-75,
and Selected Responses

EVALUATION

of

AIR QUALITY ACTIVITIES, 1974-75

I. Have your attitudes toward the air quality problem been influenced by your participation in the conference and/or workshops during the past year? If so, please explain. If not, were any previously held beliefs reinforced? Please explain.

> "My attitude toward industry has been modified a bit because in some cases they do seem to be making an effort."
>
> "Your conferences have been of great educational value to me as a new resident of this polluted area."
>
> "I think my interest in the problem has been accelerated by the workshops. My belief that something has to be done toward solving our pollution problems was reinforced."
>
> "Only that the citizens must become more involved."

II. Do you feel that you are prepared and willing to take an active leadership role in any community-based action to improve the air quality? What do you think would be the most effective role for the citizens of the community in order to improve air quality? How important do you think citizen participation is to the improvement of air quality? Do you have any specific plans for working for improved air quality in the coming year? If so, please explain.

The Ohio Valley Environmental Council and the Lung Associations activities were mentioned by several respondents as their specific plans for working on air quality.

In addition, the following two comments are representative:

> "To me, citizen participation in improvement of air quality is an integral and important aspect, and I do not feel that an air quality program can be totally successful without it."
>
> "I think citizen participation is most necessary; many things can be accomplished by the public, which cannot be accomplished by an enforcement agency."

III. *There were some segments of the community who were not represented by any participants in the sessions. Do you think the lack of their interest and participation will impede the effectiveness of any citizen action that may be planned? Are there any groups that you feel must be involved before any improvement in air quality will be noted?*

Community segments mentioned were:

- local fraternal groups
- medical groups
- more young people, especially from the College of Steubenville and Jeff Tech
- unions of local plants
- women's service clubs
- government officials

IV. *Considering the last workshop at the Millsop Community Center: do you think the small group format is more productive for the participants than larger group sessions? Was there any information, discussion, or activity during the 1 and ½ day workshop which you found particularly useful? If so, please explain.*

There was a slight preference for small groups. Most felt they were more productive for the participants, but that large group sessions were also needed to reach more community members.

The map activity was very useful to almost all respondents. The local statistics and discussion on determining health effects was also mentioned. However, the lack of definitiveness in the data was disturbing to some.

V. *If future attempts are undertaken for community education about air quality in the Valley, what suggestions do you have concerning the goals, formats, content of such activities? Do you feel the expertise of a university or group outside the community is useful in such activities? Do you think a series of workshops (e.g., once a month for 4-6 months) that required the participants to gather information, make observations and/or read material between sessions and to participate in all sessions could be successfully conducted in the community?*

See text for discussion of future activities.

VI. *Additional comments:*